

Laminated glass for motorized vehicle



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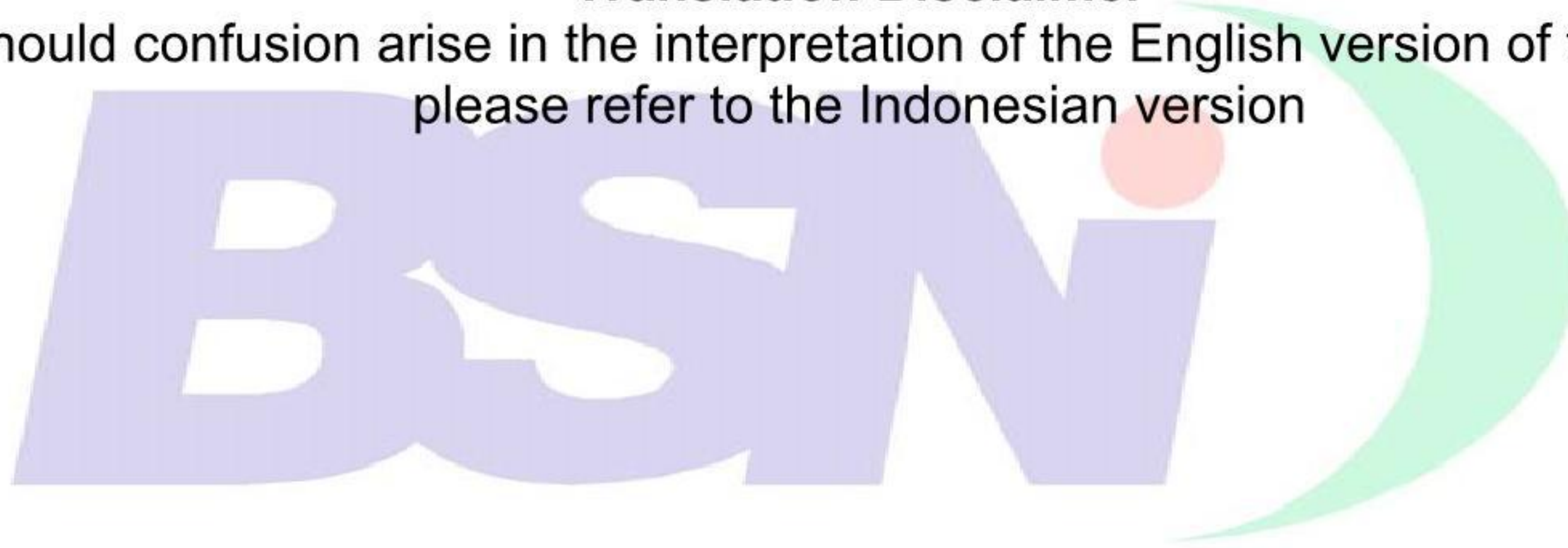




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Foreward

Standar Nasional Indonesia (SNI) *Kaca pengaman berlapis (Laminated glass) untuk kendaraan bermotor* a revision from SNI 15-1326-1998. This revision is to equalize the perception and adjustment to the existing technology.

This standard uses regional standard references atau other country's standards with high competitiveness value, however, by not disregarding the ability of Indonesian glass manufacturers.

This standard has been discussed in consensus meeting in Jakarta on January 21, 2004 attended by representatives from testing centers, manufacturers, customers, associations and related institutions.

This standard is composed by Technical Committee 33S, Non Organic Chemistry.



Laminated Glass for Motorized Vehicle

1 Scope

This standard covers the scopes, normative references, terms and definitions, classifications, quality requirements, samplings, pass requirements, testing methods, marking requirements and packaging of laminated glass for motorized vehicle.

2 Terms and Definitions

2.1

Laminated glass for motorized vehicle is a safety glass consist of 2 sheets of glasses or more glued to one each other using one or more of transparent polyvinyl butiral film whether colored or uncolored, when it is broken, the pieces shall remain attach to said polyvinyl butiral film.

3 Classification

Laminated glass for motorized vehicle classified according to the thickness of polyvinyl butiral film as follows:

Table 1 Laminated Glass Classification

Classification	Thickness of polyvinyl butiral film (mm)
A	1. 0,76 2. Double 0,76 and 0,76 3. Combination 0,76 and 0,38
B	1. 0,38 2. Double 0,38 and 0,38
Notes Windscreen shall only use the A class.	

4 Quality Requirements

4.1 Visible Characteristic

Visible characteristic of laminated glass for motorized vehicle when tested according to the point 6.1 must conform to the requirements on Table 2.

Table 2 Visible Characteristic of laminated glass for motorized vehicle

No.	Types of Defect	Requirements
1.	Fracture	Must not fracture
2.	Scratch on glass	<p>a. Windscreen</p> <p>Inside visibility area as provided at A attachment.</p> <p>Heavy scratch ^{*)}, length (1,0 – 7,0) mm.</p> <p>Medium scratch ^{**))}, length (2,0 – 15,0) mm.</p> <p>Maximum scratch in limitation above is 1 (one) scratch in an area with diameter of 300 mm.</p> <p>Outside visibility area as provided at A attachment.</p> <p>Heavy scratch ^{*)}, length (3,0 – 15) mm.</p> <p>Medium scratch^{**))}, length (5,0 – 30,0) mm.</p> <p>Maximum 1 (one) scratch in limitation above in an area of (500 x 150) mm².</p> <p>b. Other than Windscreen</p> <p>Heavy scratch^{*)}, length (3,0 – 15,0) mm.</p> <p>Medium scratch^{**))}, length (5,0 – 30,0) mm.</p> <p>Maximum 5 (five) scratches in limitation above in an area with diameter of 300 mm. Only 1 (one) heavy scratch with length (10–15) mm is allowed in an area with diameter of 300 mm.</p>

3.	Bubble on layer	Not allowed
4.	Separation of polyvinyl butiral film	No plastic separation at 5 mm open region from peripheral zone.
5.	Glass shift	For passenger motorized vehicle. No more than 1,5 mm of glass shift at closed region
6.	Stain on glass and polyvinyl butiral film	<p>a. Windscreen Inside visibility area as provided at A attachment. Radius of (0,5 -1,0) mm Maximum 3 (three) stains in limitation above in an area with diameter of 300 mm. Outside visibility area as provided at A attachment. Radius (0,5 – 1,5) mm Maximum 5 (five) stains in limitation above in an area of (150 x 500) mm².</p> <p>b. Other than windscreen Maximum 5 (five) stains in limitation above in an area with diameter of 300 mm.</p>
<p>NOTES</p> <p>*) Heavy scratch is a scratch that can be felt by fingertips.</p> <p>**) Medium scratch is a scratch that cannot be felt by a fingertip.</p>		

4.2 Dimension and Tolerance

4.2.1 Dimension of Laminated Glass

Length, width and thickness of laminated glass for motorized vehicle when tested pursuant to the point 6.2.1 and point 6.2.2 must be in accordance with Table 3.

Table 3 Length, width and thickness tolerance

In mm

Dimension	Size	Tolerance
		Length and width
Length and width	$L_p < 0,3$	2
	$0,3 < L_p < 0,8$	3
	$L_p \geq 0,8$	4
Thickness	Total thickness of glass and polyvinyl butiral film	Nominal Thickness $\pm 0,2 n$

NOTES

n is number on glass layer

L_p is width of glass in m^2

Value for length and width meant as an absolute value from its tolerance for each sample.

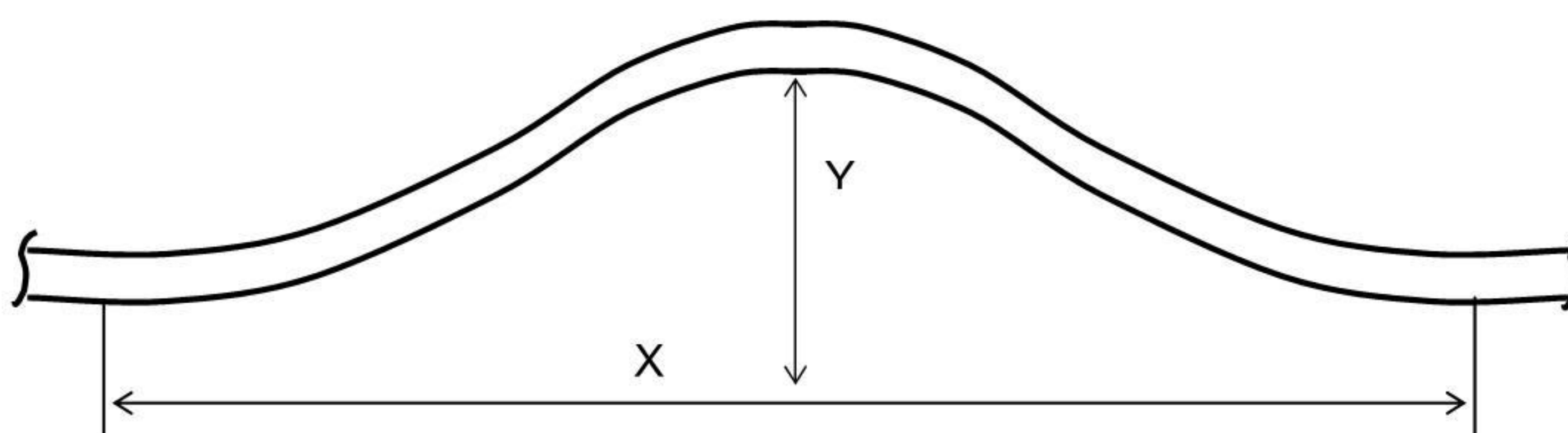
e.g.:

$(-0+2)$; $(-2+0)$; $(-1+1)$; $(0,5+1,5)$ and so on.

4.2.2 Flatness of Laminated Glass

Flatness of laminated glass for motorized vehicle, as the result of flatness measurement in accordance with point 6.2.3 must not exceeding 0,5 % at curve and 0,5 % at wave shape.

Curve laminated glass is exempted from this requirements.



$$\frac{Y}{X} \times 100 \% \leq 0,5 \%$$

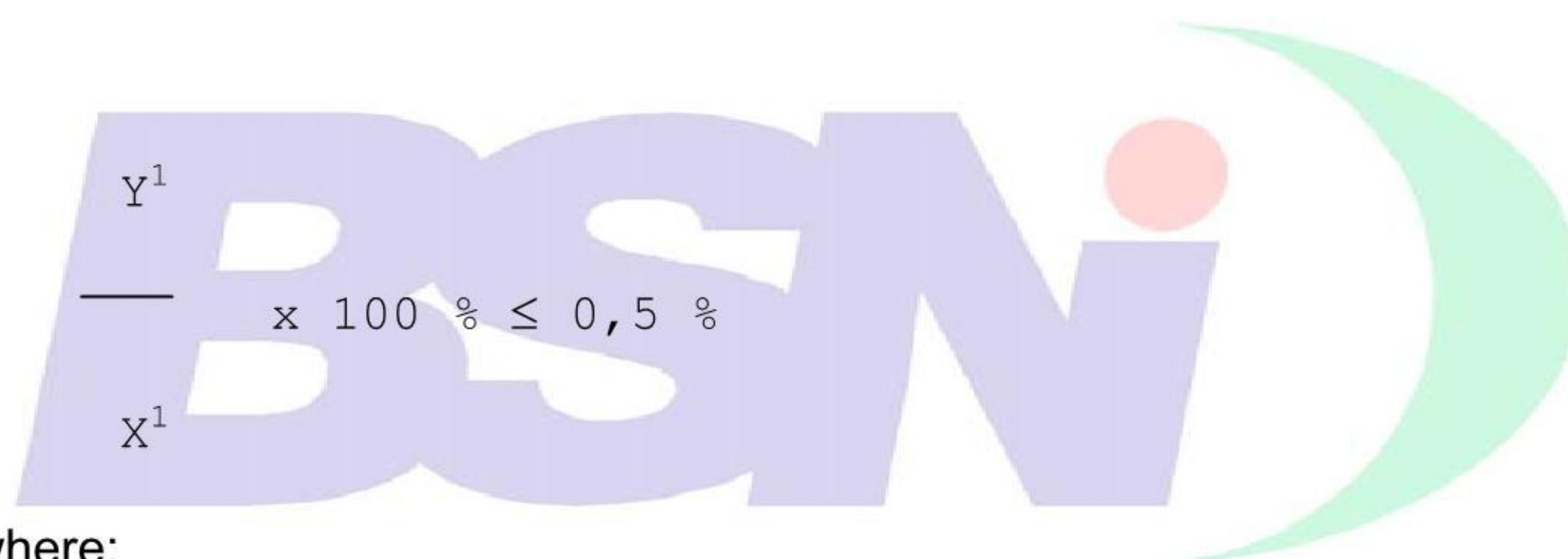
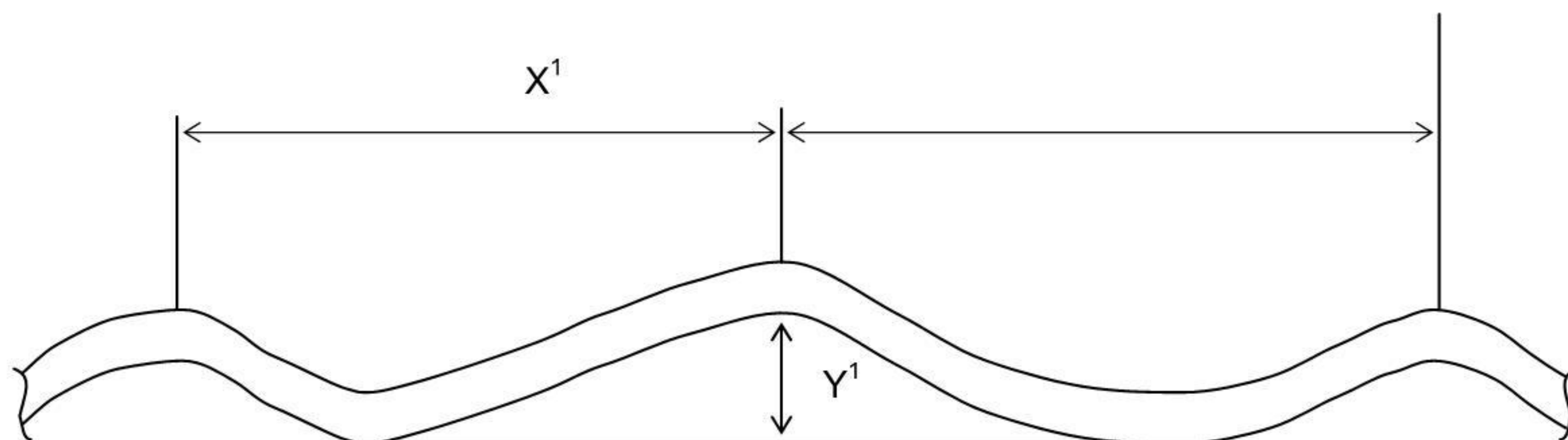
X

where:

Y is the height or depth of curve (arch);

X is the length of curve arch.

Figure 1a Types of Curve



where:

X^1 is distance between the highest wave peak and the nearest wave peak;

Y^1 is height of highest wave peak.

Figure 1b Types of wave

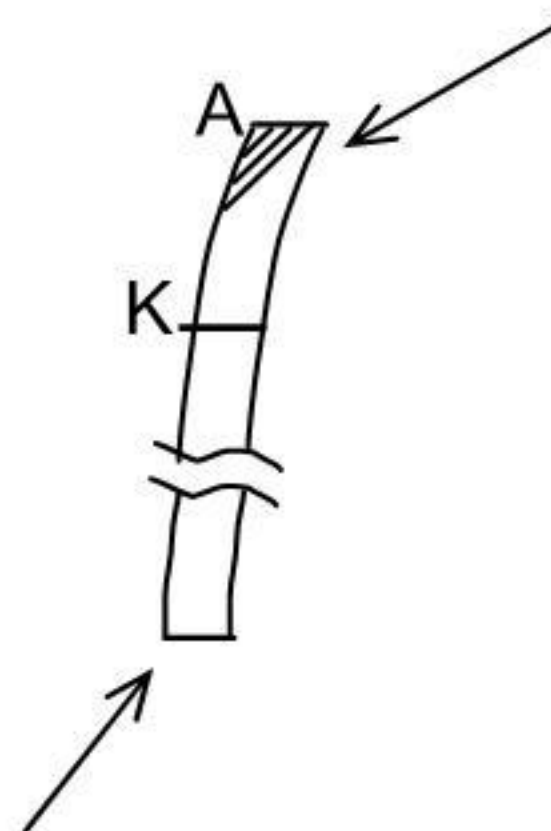
4.3 Optic Quality

4.3.1 Light Transmission

Laminated glass for motorized vehicle must follow the light transmission power provisions as follows:

When windows are tested according to point 6.3.1 light transmission resulted by A illuminator standard after passing of 70 % transparent glass, except at the shade band side.

Shade Band



Obscuration band

NOTES Size of shade band (A-K) not exceeding test area

Figure 2

Area where measurement light transmission is performed

4.3.2 Optical Refraction

Purpose of this testing is to determine whether the shadow separation caused by test sample impair the driver's sight or not.

If laminated glass for windscreen or front door of motorized vehicle is tested in accordance with point 6.3.2 result of sample test must be pursuant to the requirements on Table 4.

Table 4 Optical Refraction

Testing Area		Maximum shift (arch minute)
Windscreen	Front window	
A or a	-	15
B or b	D	25
I or c	-	15
-	E	25

4.3.3 Optical Distortion

Purpose of this testing is to determine whether the distortion caused by safety glass impair the driver's sight or not.

If laminated glass for windscreen or front window of motorized vehicle is tested in accordance with point 6.3.3 it must be fulfill the requirements as follows:

- 1) When using projection the circle must fulfill the provision on Table 5.

Table 5 Optical Distortion

Testing Area		Maximum shift (arch minute)
Windscreen	Front window	
A or a	-	2
B or b	D	6
I or c	-	2
-	E	6

- 2) When using layered screen it must be fulfill the provisions as follows:
 - a) Must not creating split shadow from projected lines and easily seen by normal eyes.
 - b) Projection lines may relatively curve against lines on the screen. However, said projection lines must not exceed or pressed with the next lines on the screen. This mean equal to maximum primary deviation ± 8.4 minutes ($0^{\circ} 8.4'$) arch.

4.3.4 Color Identification

Laminated glass for motorized vehicle must not cause change of color when driver see the object through visibility area.

Light which come through the visibility area of laminated glass may be white, yellow, red, green, blue and amber according to its original color.

4.4 Radiation Resistance

Laminated glass for motorized vehicle when tested in accordance with point 6.4 must fulfill the requirements as follows:

- a) Light transmission not decrease below 95% from initial level before testing.
- b) Light transmission not decrease below 70% after testing.
- c) Test sample must not change after the testing, when observed on white screen and there is no other stain.

4.5 High Temperature Resistance

Laminated glass for motorized vehicle, when tested in accordance with point 6.5 must fulfill the requirements as provided at Table 6 as follows:

Table 6 High Temperature Resistance

Types	Condition after testing
A and B	<p>Sample test may fracture, but must not have any defect in an area more than 15 mm from peripheral zone or in an area more than 10 mm from fracture location.</p> <p>If sample test comes from its original product, then it is not allowed for fracture more than 25 mm from said peripheral cutting edge.</p>

4.6 Collision Resistance

Laminated glass for ground vehicle when tested in accordance with point 6.6 must fulfill the requirements as provided on Table 7 below:

Table 7 Collision Resistance

Types	Condition after collision
A	Sample test surface is not penetrated by steel ball
B	Weight of fraction which came off from opposite surface with maximum collision direction of 20 gram

4.7 Penetration Resistance

Laminated glass for motorized vehicle when tested in accordance with point 6.7 must fulfill the requirements as provided at Table 8 below.

Table 8 Penetrated Resistance

Types	Condition after test
A	Sample test surface is not penetrated by steel ball in 5 seconds
B	Not required

4.8 Collision resistance on mannequin head

Laminated glass for motorized vehicle when tested in accordance with point 6.8 characteristic of front area that collided must fulfill the requirements as follows:

- Fracture of sample test forming a circle, nearest fracture circle with collision center spaced maximum of 80 mm from collision point.
- Fracture still attach to polyvinyl butiral film, unless in several places in radius of 60 mm at collision point.
- Open side of collision of polyvinyl butiral film must not exceeding 2000 mm²
- Length of broken polyvinyl butiral film is maximum 35 mm.

If using sample test in size of:

$$\begin{array}{cc}
 + 5 \text{ mm} & + 5 \text{ mm} \\
 1100 & \times 500 \\
 - 2 \text{ mm} & - 2 \text{ mm}
 \end{array}$$

Must fulfill the requirements as follows:

- Mannequin head which dropped from 4 m height, not penetrate the sample test
- No large endanger fracture that come off from polyvinyl butiral film.

4.9 Abrasion Resistance

Laminated glass for motorized vehicle when tested in accordance with point 7.9 the maximum gloominess value after abrasion is 2%.

4.10 Humidity Resistance

Laminated glass for motorized vehicle when tested in accordance with point 6.10 must not have mist more than 10 mm from original peripheral zone or 15 mm from new cutting peripheral zone of sample test.

5 Sampling Method

5.1 Sampling conducted by an authorized officer.

5.2 Sample test that shall be valued is randomly selected with double *sampling plan*, on B attachment.

5.2.1 If the sample test which shall be taken is the original size of glass which has been packed, package selection shall be conducted by lottery or using random figure table or random figure generator at scientific calculator.

When amount of sample test in package above is not sufficient, other package shall be taken with method same as above. If amount of sample test in selected package exceed the required sample determination of sample test taken shall be conducted by lottery.

5.2.2 For testing material which prepared for radiation resistance test, high temperature resistance, collision resistance, penetrate resistance, mannequin head collision test, abrasion resistance and humidity resistance on laminated glass for motorized vehicle, the preparation must be witnessed by officer who take sample test with the same material to its original size of glass in accordance with point 6.2.1.

5.3 Size of sample test used in accordance with Table 10 Amount of Sample Test and Test Requirements.

5.4 Minimum amount of sample test taken in accordance with Table 10 Amount of Sample Test and Test Requirements.

NOTES Double Method that is sampling method, if the first sampling is failed, the second sampling shall be conducted

6 Test Method

6.1 Visible Characteristic

Characteristic test is visually performed within 50 cm from sample test surface (without aid from optical tools). Under the bright light if necessary. Supervision is aimed to all outside and inside surfaces of sample test.

6.2 Dimension and Tolerance

6.2.1 Thickness

Thickness must be measured with micrometer with minimal tolerance of 0.01 mm and the result may be rounded up to 2 (two) decimal in millimeter unit.

6.2.2 Length and Width

Length and width must be measured with metering device with tolerance of 1 mm.

6.2.3 Flatness

Flatness must be measured with a straight ruler that applied on vertical sample. If flatness curve is stated in percentage of comparison between curve height and its length. If flatness wave is stated in percentage of comparison between the highest wave peak with distance between that wave peak to the nearest wave peak.

6.3 Optic Quality

6.3.1 Light Transmission

Light transmission testing is conducted with standard illuminator for example an incandescent gas lamp with color temperature 2854° K. Test sample must vertically placed with 5° tolerance against the light produced by the test equipment.

6.3.2 Optical Refraction

6.3.2.1 Testing Condition

Testing must be conducted by placing sample test to form certain angle against vertical line like its original position on the vehicle. This testing must be done in a dark room in order for secondary shadow would be easily and clearly seen the difference.

6.3.2.2 Equipment

This equipment consist of box with size around 305 mm x 305 mm x 150 mm. Front side of the box must have center hole with diameter of 12.7 mm and two circles (ring) concentric with inter diameter of 79,2 mm and 123,5 mm with respective width around 2 mm. Front side of the box may be made of glass covered with black lightproof material or metal sheet, line connecting the holes must be small and adjusted at 45° degree to ordinate and abscissa. Box illuminated with incandescent lamp of 15 watt - 25 watt. Center hole covered with yellow red light filter, such as red ilford 608 (see figure 3).

6.3.2.3 Procedure

Light box must be positioned to make the center target located at horizontal line that shall through the center of windscreen that placed at 7600 mm from light box. Sample test positioned in certain angle just like its original position on the vehicle with the same surface height and facing to the light box. Light box shall be seen through every main visibility area to determine the existence of secondary shadow in its connection with illumination target.

Windscreen laterally shifted and cuts projection line to maintain visibility normality at horizontal area which remains at 7600 mm from light box to the sample test in said certain angle.



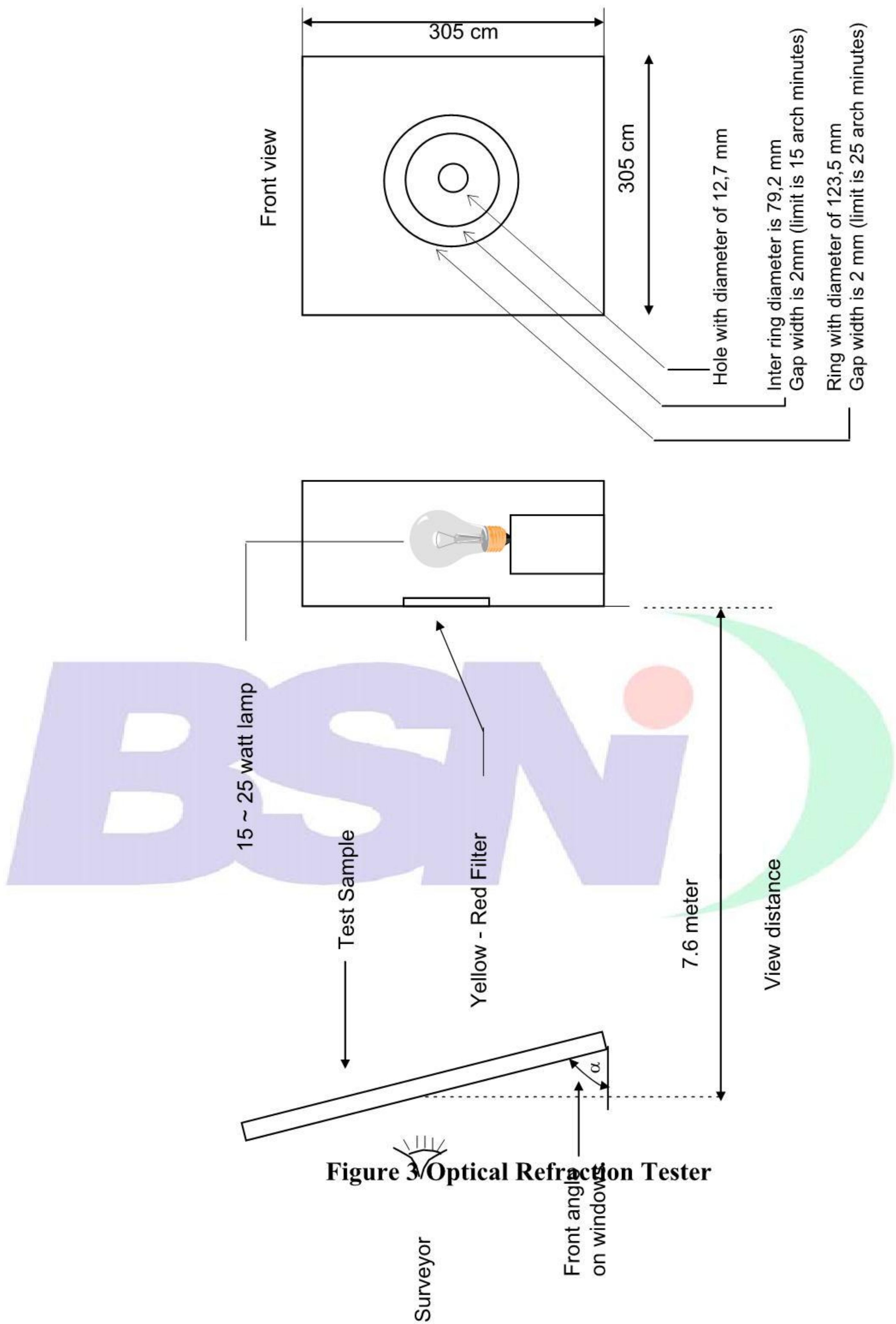


Figure 3 Optical Refraction Tester

6.3.3 Optical Distortion

6.3.3.1 Testing Condition

Testing conducted by placing sample test at certain angle against vertical line like its original position on the vehicle.

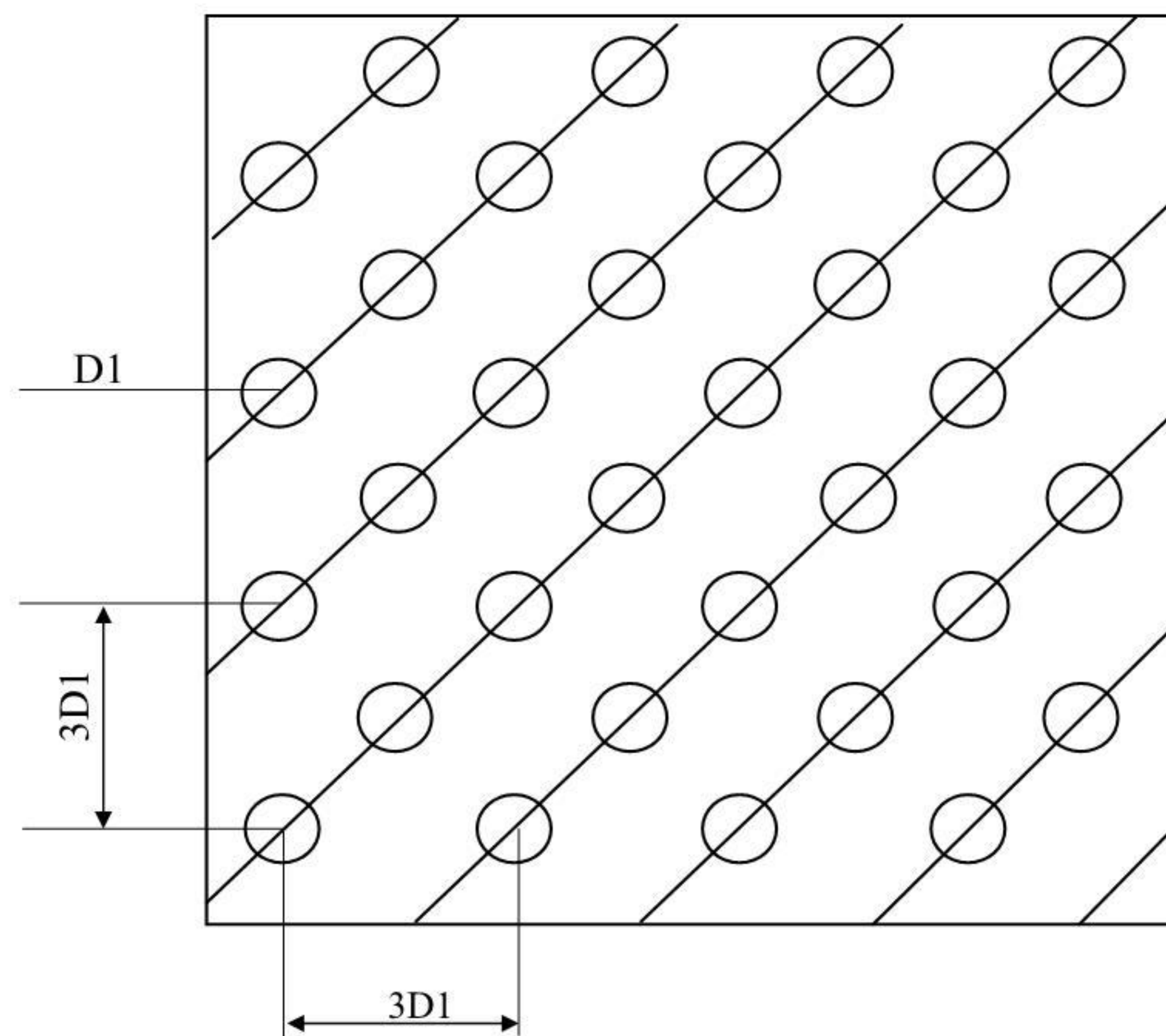
6.3.3.2 Using Ring Projection Circle

1) Tools

Tolls consist of:

- A projector lamp that can sharply project the image on a screen in a distance of 8000 mm with its focus has been adjusted.
- A projector with minimum 150 watt with object lens that has minimum focus distance of 90 mm shall be suitable for this testing.
- A flat white screen.
- Slide which able to produce shadow on the screen as provided at Figure 4.



**Note:**

D_1 is centerline of circle on the screen;

Figure 4 Circle Projection on the screen

$$R_1 + R_2$$

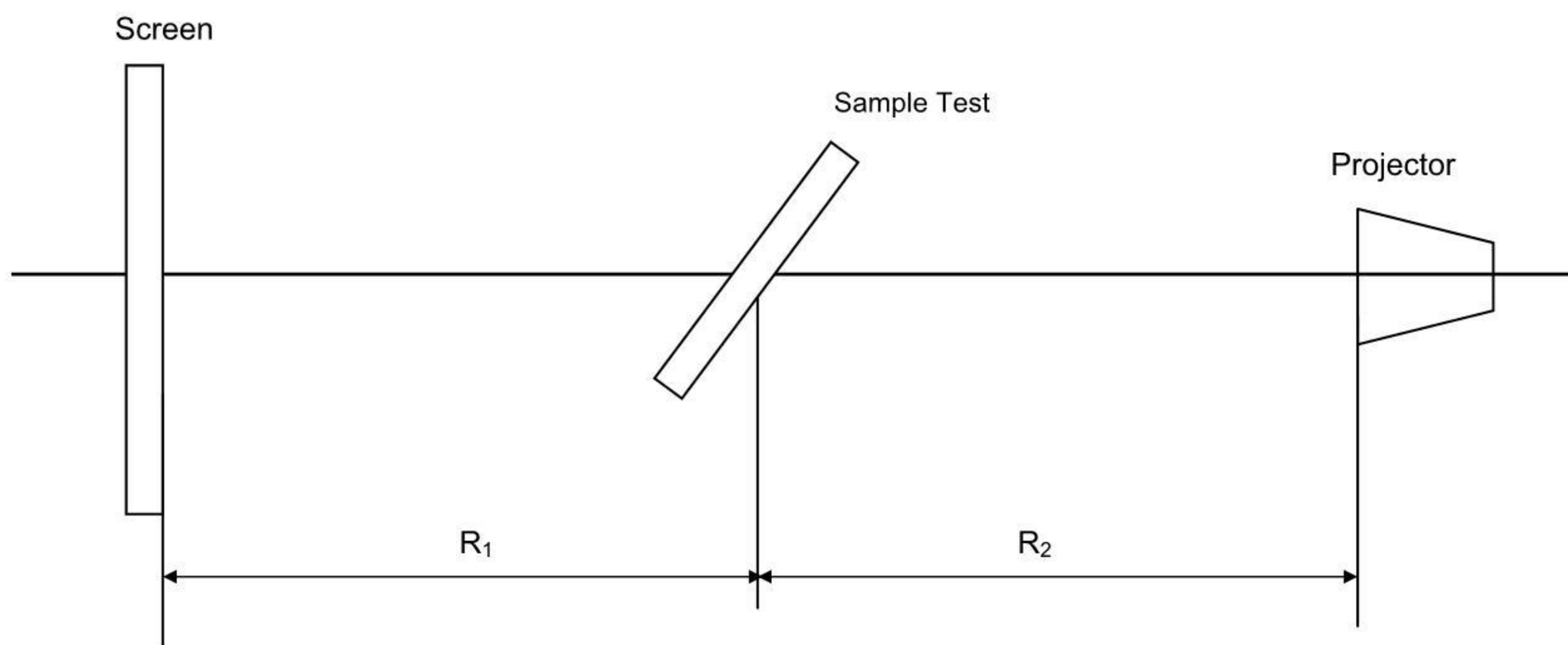
$$D_1 = \frac{R_1 + R_2}{R_1} \times 4$$

where:

D_1 is centerline of circle on the screen;

R_1 is distance of projector to the sample test;

R_2 is distance of glass to the screen.

**Note:**

R_1 is distance of projector to the sample test;

R_2 is distance of glass to the screen.

Figure 5 Test position to the screen and projector

2) Procedure

Windscreen must be placed in an angle in accordance with the installation angle on the vehicle, facing the light source in a distance of 4000 mm and 4000 mm to the lined screen.

Windscreen may be laterally moved crossing the projection line in horizontal area by fixedly placing in a distance of 4000 mm from light box to the glass on said certain angle. Slide shadow then projected via sample glass to the screen in order to know the difference of circle diameter before and after being penetrated by the light.

6.3.3.3 Using lined screen**1) Tools**

Tolls consist of:

- A projector lamp that can sharply project the image on a screen in a distance of 8000 mm with its focus has been adjusted.
- A white screen with minimum height of 180 cm added with red lines with thickness of 1,5 mm in a distance of 21,6 mm between each other. Those Lines were stretched above with 30° angle toward horizontal side of the screen.

- c) Projected slide must be precisely form the falling shadow on lines in the screen and centered at 8000 mm from lamp. Said slide may be made of by taking picture of its own screen. Little distance adjustment between lamp and screen is allowed in order the shadow actually pressed with lines on the screen.

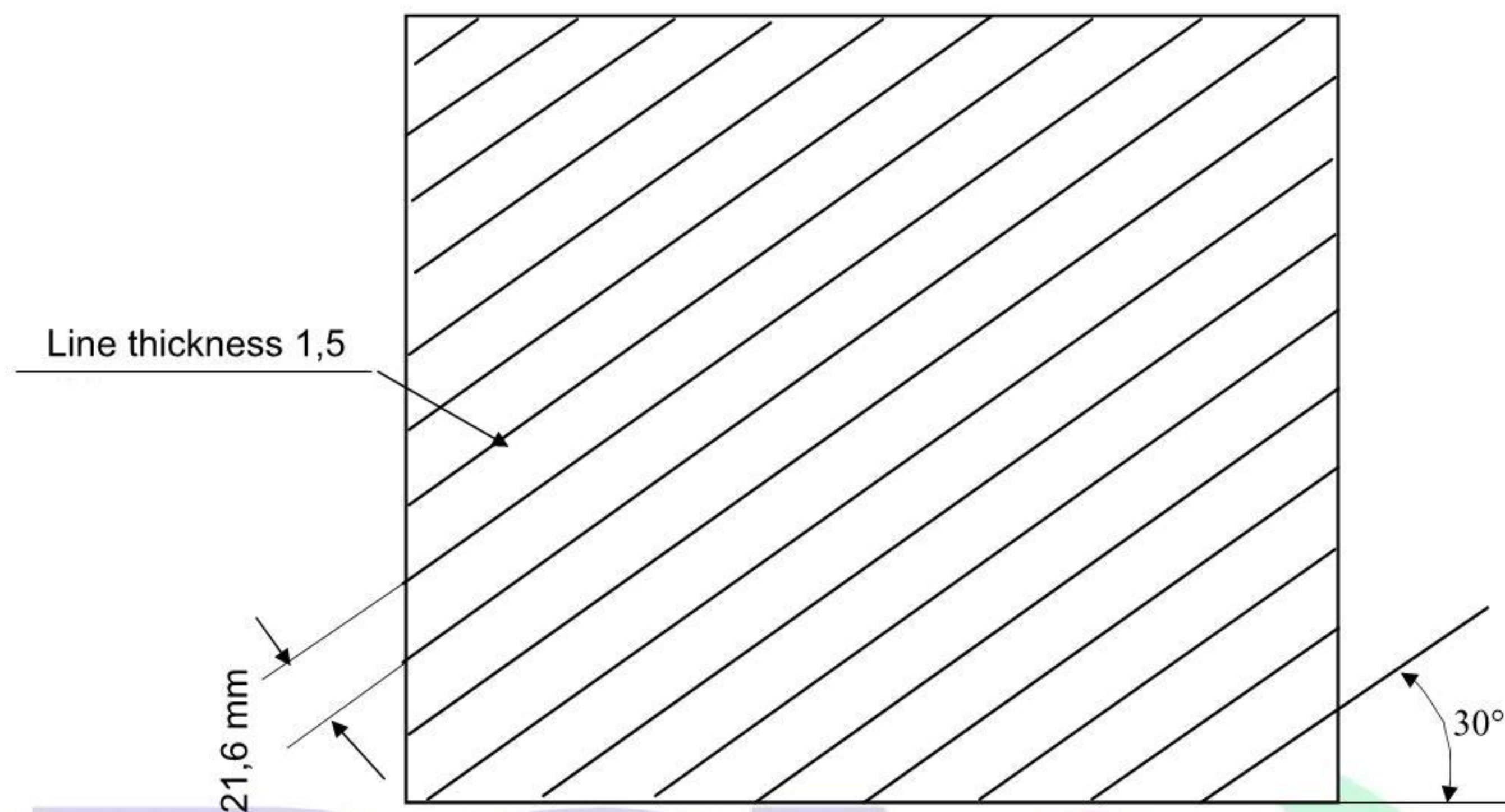


Figure 6 Lined Screen

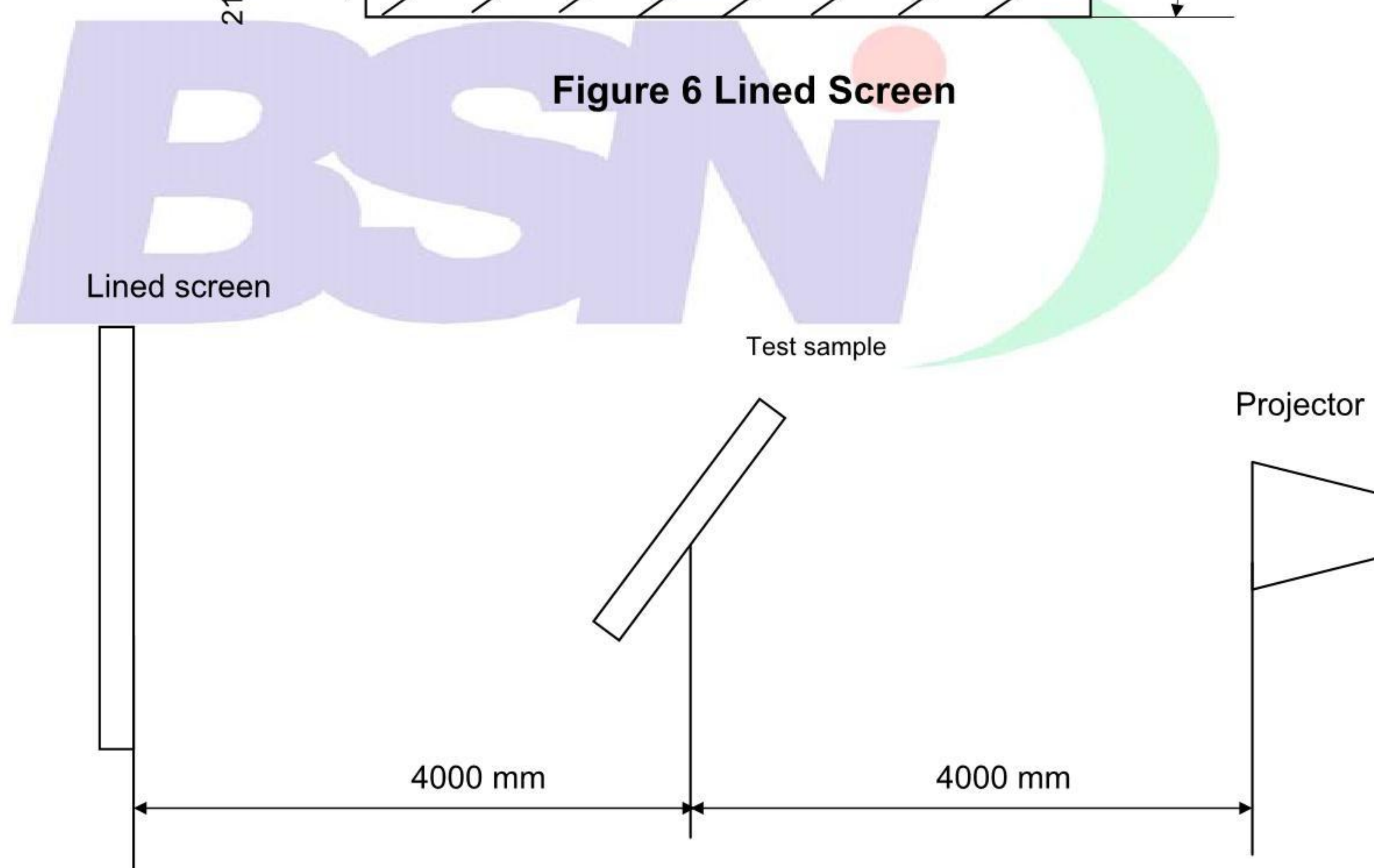


Figure 7 Position of sample test to the lined screen and projector

2) Procedure

A flat high quality glass, with thickness same as windscreen is installed at the angle in accordance with the angle of tested windscreen, placed between lamp and screen.

Subsequently, lined screen is adjusted in order to have the correct shadow so the projected lines shall fall at close quarters with lines on the screen. Then, said flat glass is separated.

Windscreen must be placed at a certain angle, facing the light source in a distance of 4000 mm from lined screen, at the previous location of flat glass.

Windscreen may be laterally moved crossing the projection line in horizontal area by rotating to maintain the sight normality in horizontal area by placing in a distance of 4000 mm from light box to the glass at certain angle. Slide shadow then projected via sample glass to the screen in order to be analyzed in detail.

6.3.3.4 Color Identification

Laminated glass for motorized vehicle must be tested to verify whether there is a color change when the light is come through the visibility area, especially for white, yellow, red, green, blue and amber. Place a colored lamp (object) in front of glass so the light comes through its visibility area. See the light from behind glass, whether the light still seen as its source color.

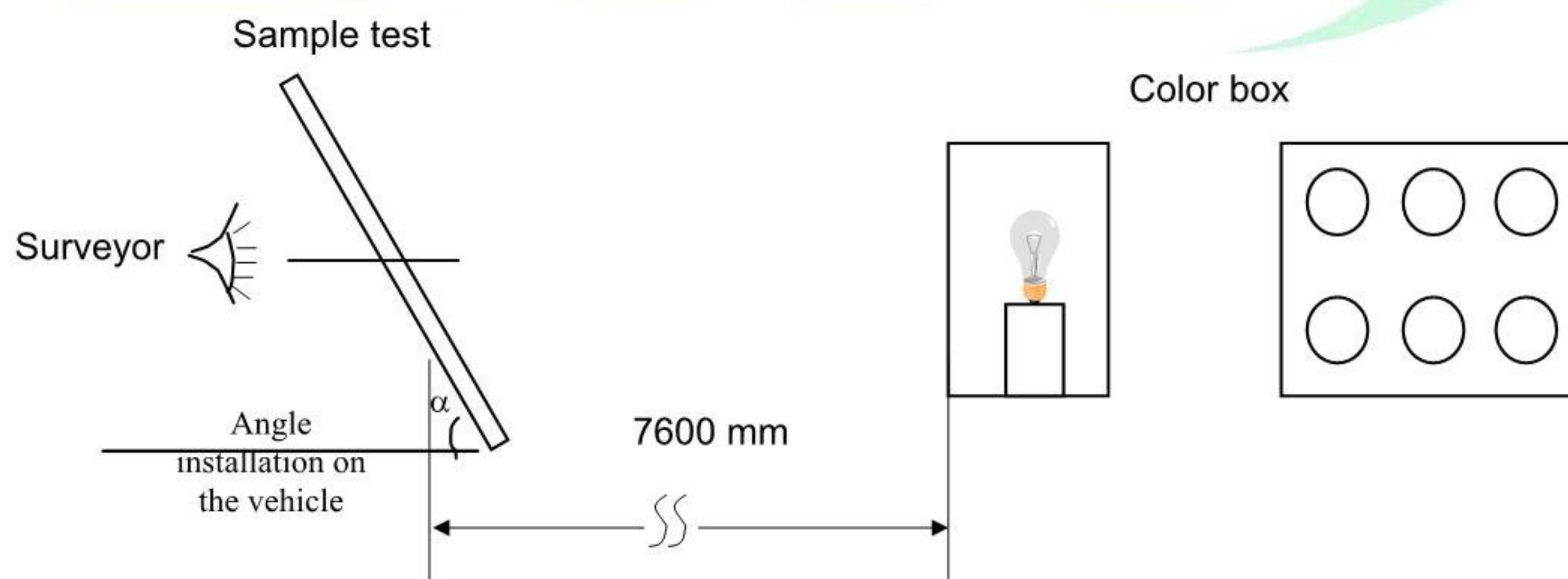


Figure 8 Color Identification Tester

6.4 Radiation Resistance

6.4.1 Tools

- a) Ultraviolet ray, this tools must equipped with mercury lamp "*quartz glass*" with 750 ± 50 watt power or light source equal to said tools where the temperature can be adjusted.
- b) Spectrophotometer or "*light meter*"

6.4.2 Procedure

Measure the light transmission appears on the test sample such as test procedure as provided at point 6.3.1 (before illumination). Place sample test on ultra violet tool with temperature of $45^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and in a distance of 230 mm from said ultra violet source in such way in accordance with outer side of glass when installed on the vehicle. This test is conducted for 100 hours.

Measure the light transmission appears on the test sample such as test procedure as provided at point 6.3.1 (after illumination). Visually analyze the change and calculate the margin of light transmission occurred.

6.5 High Temperature Resistance Test

6.5.1 Tools

- container to boil the water;
- water container at certain temperature, for initial boiling;
- sample buffer.

6.5.2 Procedure

Place the sample test in its container (buffer). Put into container filled with water at temperature of $\pm 65^{\circ}\text{C}$ for 3 minutes. Quickly move the sample test into boiled water and let it for 2 hours. Lift the sample and analyze the result for bubbles and other defects.

6.6 Collision Resistance Test

6.6.1 Tools

- test material buffer as in figure 9;
- (225 ± 5) gram of steel ball with diameter of ± 38 mm.

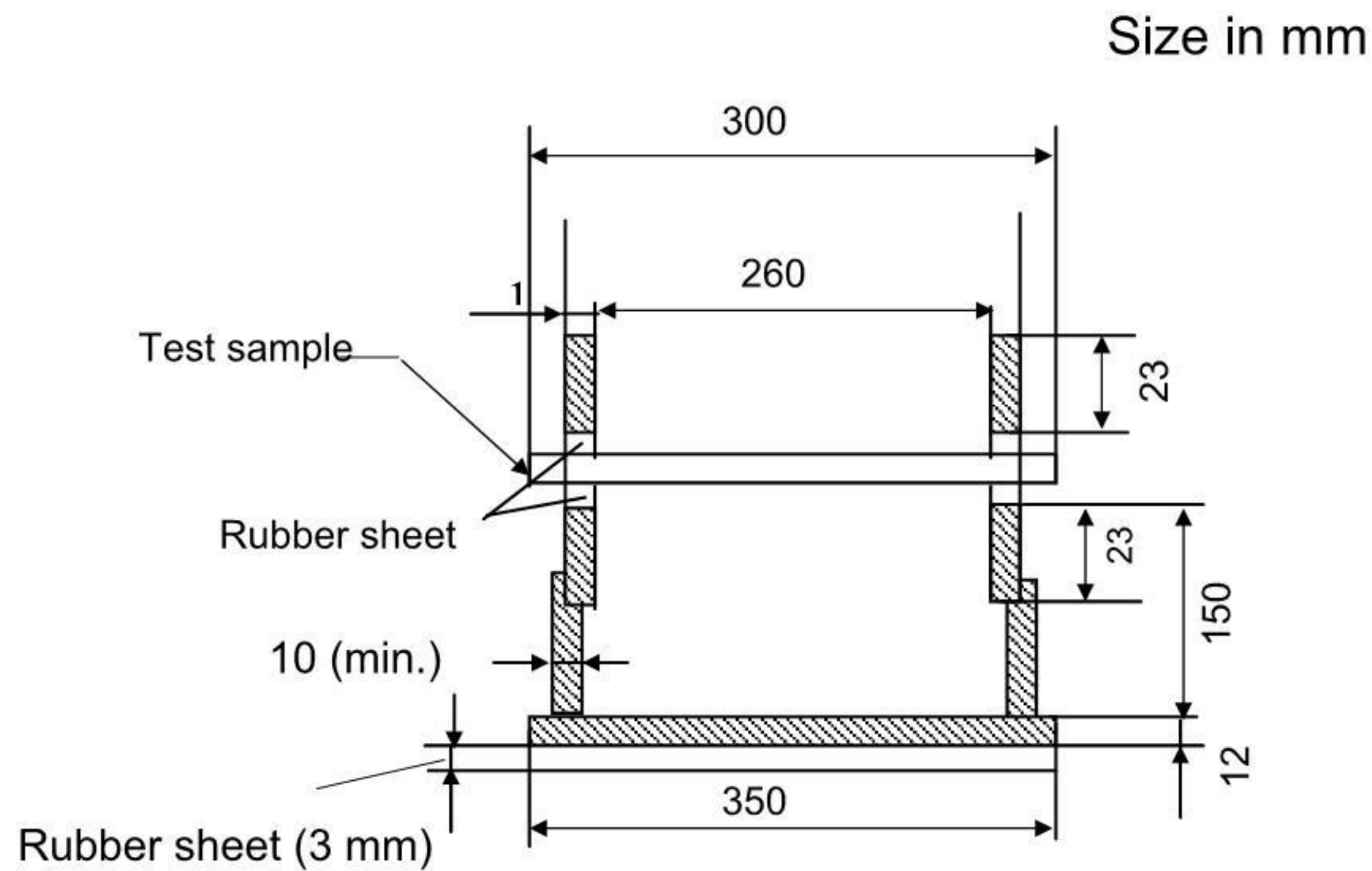


Figure 9 Buffer for collision resistance of test material and penetrate resistance

6.6.2 Procedure

Before testing, sample test must be stored in room temperature ($27^{\circ}\text{C} \pm 4^{\circ}\text{C}$) for minimum 14 hours. Horizontally placed the sample test on the buffer. Drop steel ball from 9 m. The ball must fall on the center or maximum 50 mm from center of test sample. Analyze the result.

6.7 Penetrate Resistance

6.7.1 Tools

- buffer for test material as in figure 9;
- steel ball with a weight of (2260 ± 20) g, and diameter of 82 mm.

6.7.2 Procedure

Before testing, sample test must be stored in room temperature ($27^{\circ}\text{C} \pm 4^{\circ}\text{C}$) for minimum 4 hours. Horizontally placed the test sample on buffer and inner-part of product which will experience the collision.

Drop the steel ball from 4 m. Ball must fall on the center or maximum 25 mm from center of test sample. Analyze the result.

6.8 Resistance Test on Mannequin Head

6.8.1 Tools

Mannequin head made of hard wood in shaped of ball with diameter of $190 \text{ mm} \pm 2 \text{ mm}$ where half of the bottom part wrapped with soft material with thickness of 5 mm. Wight of this tool is $10 \text{ kg} \pm 0,2 \text{ kg}$ and must be able to fall freely. Buffer of test sample made of iron frame with minimum height of 300 mm from floor or test sample buffer with curve in accordance with curve of test sample, so all peripheral zone of test sample hit the said buffer. Around the frame rounded with rubber with width of approximately 15 mm, thickness of 3 mm, and hardness value of 50 IRHD.

6.8.2 Procedure

Before testing, sample test must be stored in room temperature ($27^{\circ} \text{C} \pm 4^{\circ} \text{C}$) for minimum 4 hours. Horizontally placed the test sample on the buffer and clipped perfectly (test sample only).

Test sample is placed in such way so the inner part of the glass shall experience the collision.

Drop the mannequin head from 1,5 m for original glass size, 4 m for test sample.

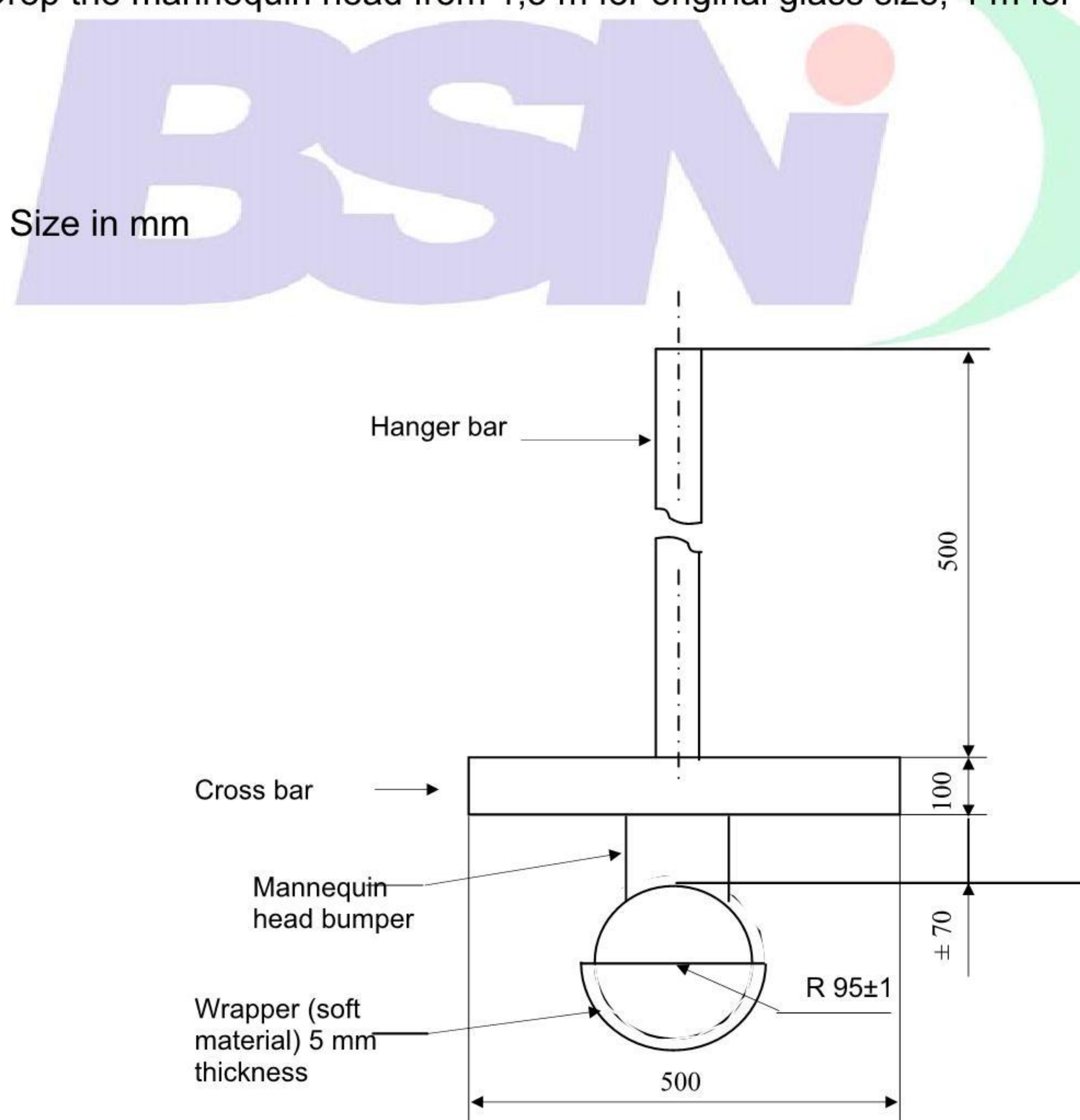


Figure 10a Mannequin Head Test Tools

Size in mm

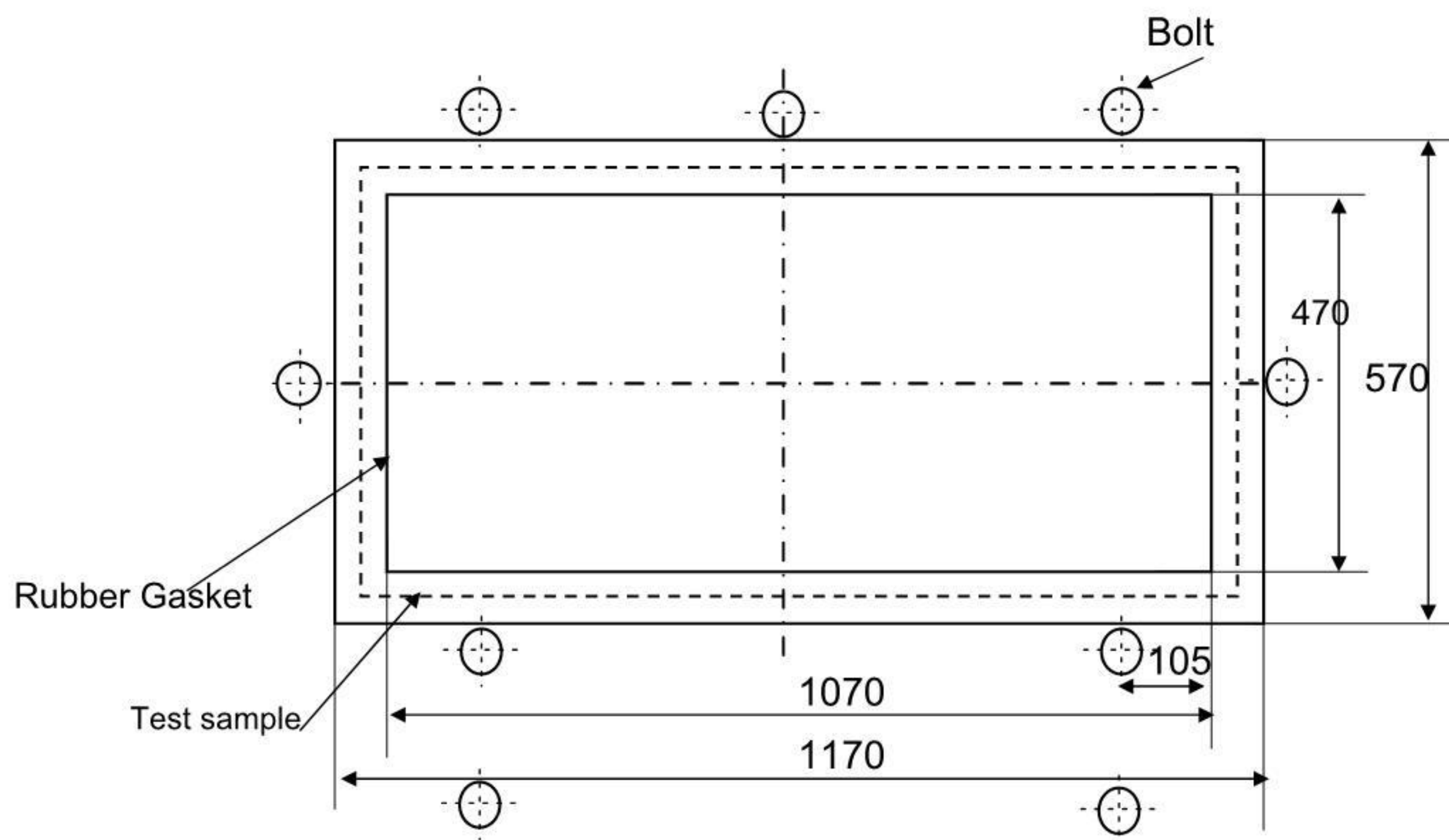


Figure 10 b Buffer Table

6.9 Abrasion Resistance Test

6.9.1 Tools

Abrasion tools consist of:

- A disc that spin horizontally with speed of $70 \text{ rpm} \pm 5 \text{ rpm}$ and pair of spinning abrasion road. Disc must be able to spin in an area and weight of 500 grams (4,9 N) assigned to test sample by respective abrasion road.
- Abrasion road with thickness around 12,5 mm and center line of 40 mm – 50 mm made of half harden rubber wrapped with special material. This positioning must be done in such way so there is no vibration or axis deviation. Abrasion road hardness value is $(72 \pm 5) \text{ IRHD}$.
- Hazemeter must consist of light source with illuminator lamp as its source and circle receiver in accordance with figure 12. This Hazemeter is to measure “diffusion” light due to abrasion and must fulfill the requirements as follows:
 - source of light for illuminator lamp with color temperature of $2856^{\circ}\text{K} \pm 50^{\circ}\text{K}$,
 - light source must use *anastigmatic* lens with diameter of $7 \text{ mm} \pm 1 \text{ mm}$ to obtain a genuine parallel light;

- receiver must consist of electric photo cell and integrated circle equipped with ray catcher and deflection standard.

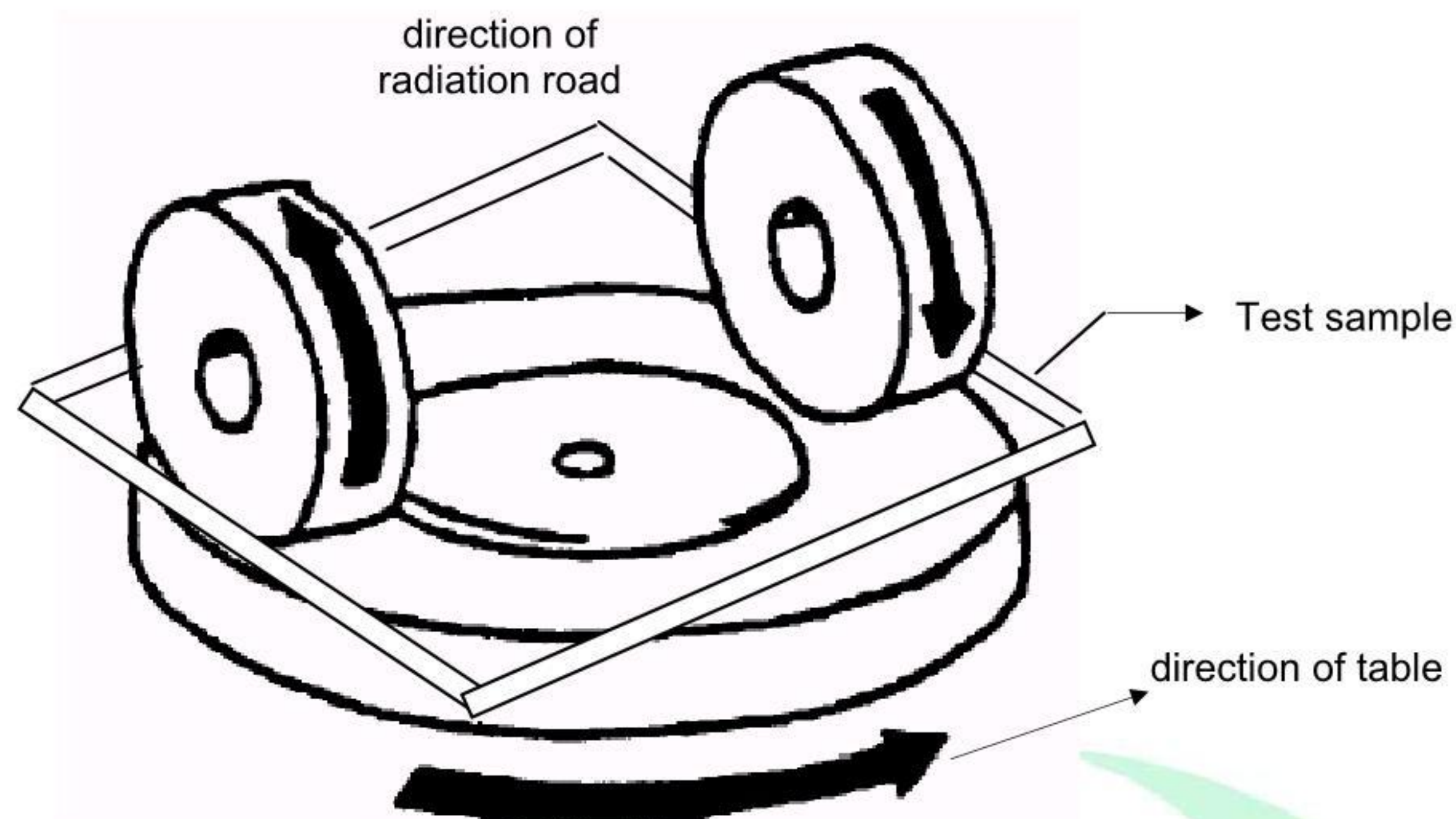


Figure 11 Abrasion Test Tools

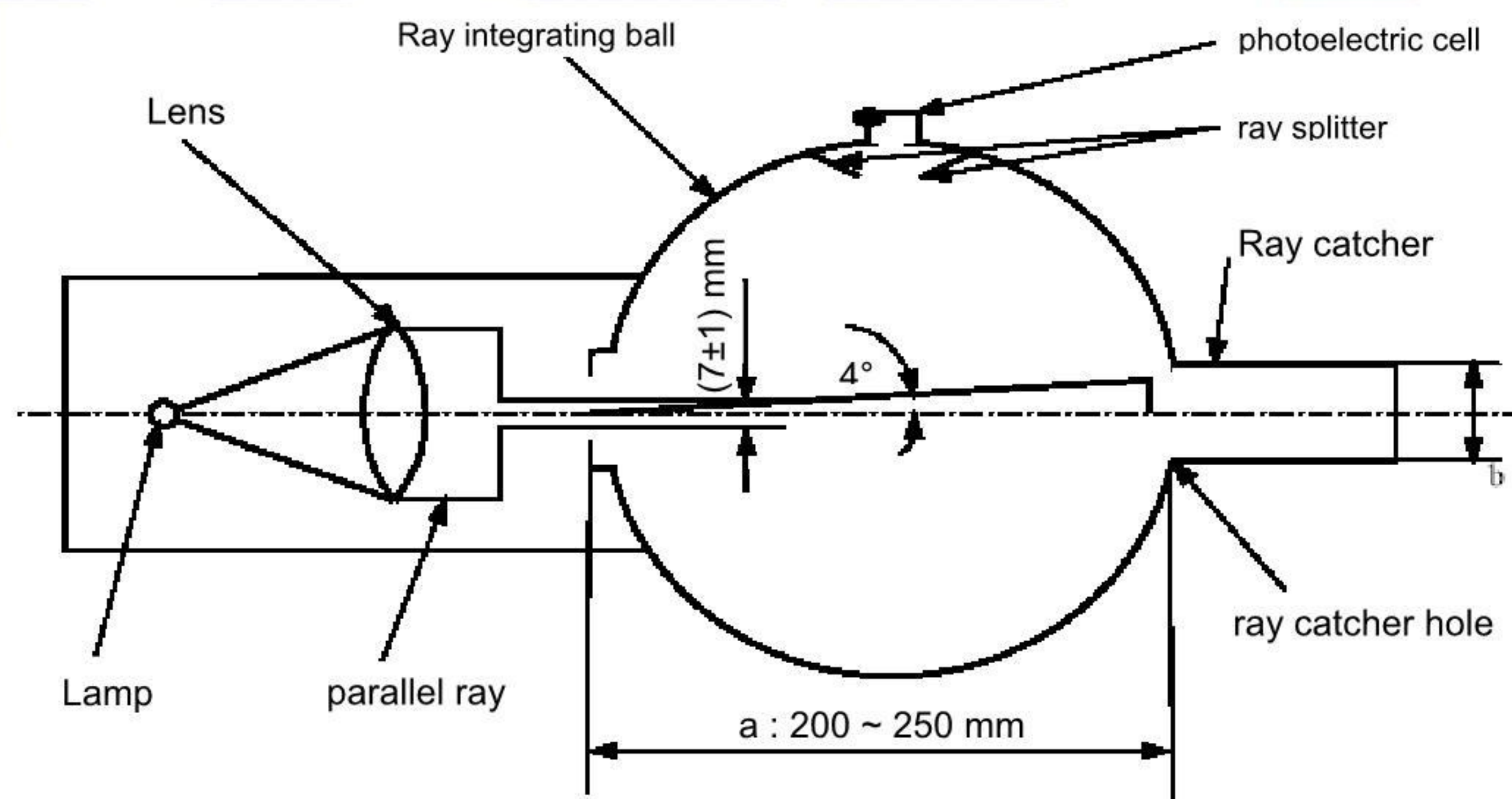


Figure 12 Hazemeter

6.9.2 Procedure

Clean the test sample and calculate its haze value at 4 locations that will be passed through by abrasion road, therefore the average value can be determined.

Place the test sample on a disc of abrasion tools so the surface of abrasion road works as scrapper and add a weight of 500 grams (4,9 N) at every abrasion road for 1000 spins. Clean the test sample after abrasion and count the haze value of said test sample with hazemeter at 4 locations which have been passed through by abrasion road so the average values can be determined. Surface of test sample which experienced by abrasion must faced to the source of light.

Calculate the haze value using the formula below after obtaining the measurement result on Table 9.

$$\text{Total transmission (Tt), \%} = \frac{T_2}{T_1} \times 100 \%$$

$$\text{Diffusion Transmission (Td), \%} = \frac{T_4 - T_3 \times \frac{T_2}{T_1}}{T_1 - T_3} \times 100 \%$$

$$\text{Haze value (H), \%} = \frac{T_d}{T_t} \times 100 \%$$

where:

T_1 is reading of light transmission without test material and without ray which captured with deflection standard;

T_2 is reading of light transmission with test material without captured and deflection standard;

T_3 is reading of light transmission without test material and ray which captured without deflection standard;

T_4 is reading of light transmission with test material and ray which captured without deflection standard;

T_t is total light transmission;

T_d is diffusion of light transmission;

H is haze value.

Table 9 Reading of light transmission for abrasion test resistance

Reading	with test material	with captured ray	with deflection standard	Represented amount
T1	No	No	Yes	Passing ray
T2	Yes	No	Yes	Ray amount
T3	No	Yes	No	Ray that spread by tools
T4	Yes	Yes	No	Ray that spread by tools and test material

6.10 Moisture Test resistance

Place the test sample in vertical in closed tools in temperature of $50^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and relative moisture of $95\% \pm 4\%$ for two weeks. Set the distance among the test sample (test sample must not touched with each other).

7 Pass Requirements

7.1 Visible Characteristic

Three sheets of laminated glass for motorized vehicle are tested according to test method as provided at point 6.1 when all glasses has fulfilled the requirements glasses are declared have passed the test, if only two sheets fulfill the requirements, perform testing on three new sheets of test sample and if all glasses fulfill the requirements glasses are declared have passed the test.

7.2 Dimension and Tolerance

Three sheets of laminated glass for motorized vehicle are tested according to test method as provided at point 6.2 when all glasses has fulfilled the requirements glasses are declared have passed the test, if only two sheets fulfill the requirements, perform testing on three new sheets of test sample and if all glasses fulfill the requirements glasses are declared have passed the test.

7.3 Optic Quality

7.3.1 Light Transmission

Three sample sheets of layered safety glass with size adjusted to the tools used (spectrophotometer) is cut from the original glass or made in accordance with original glassmaking method, when tested according to test point 6.3.1 when all glasses has fulfilled the requirements glasses are declared have passed the test, if only two sheets fulfill the requirements, perform testing on three new sheets of test sample and if all glasses fulfill the requirements glasses are declared have passed the test.

7.3.2 Optical Deviation

Three sheets of laminated glass for motorized vehicle are tested according to test method as provided at point 6.3.2 when all glasses has fulfilled the requirements glasses are declared have passed the test, if only two sheets fulfill the requirements, perform testing on three new sheets of test sample and if all glasses fulfill the requirements glasses are declared have passed the test.

7.3.3 Optic Distortion

Three sheets of laminated glass for motorized vehicle are tested according to test method as provided at point 6.3.3 when all glasses has fulfilled the requirements glasses are declared have passed the test, if only two sheets fulfill the requirements, perform testing on three new sheets of test sample and if all glasses fulfill the requirements glasses are declared have passed the test.

7.4 Radiation Resistance

Three sample sheets of layered safety glass with size of 300 mm x 300 mm or 300 mm x 76 mm cut from original glass on the flattest area or made in accordance with original glassmaking method, when tested according to test point 6.4 when all glasses has fulfilled the requirements glasses are declared have passed the test, if only two sheets fulfill the requirements, perform testing on three new sheets of test sample and if all glasses fulfill the requirements glasses are declared have passed the test.

7.5 High Temperature Resistance

Three sample sheets of layered safety glass with size of 300 mm x 300 mm cut from original glass where one of its side constitute the original side of the glass and when tested according to point 6.5.2 when all glasses has fulfilled the requirements glasses are declared have passed the test, if only two sheets fulfill the requirements, perform

testing on three new sheets of test sample and if all glasses fulfill the requirements glasses are declared have passed the test.

7.6 Collision Resistance

When six sheets out of eight sheets of layered safety glass in size of 300 mm x 300 mm made in accordance with original glassmaking method, when tested according to test point 6.6 then glasses are declared have passed the test.

If only four sheets of test sample fulfill the requirements above, all glass samples is declared have failed the test.

If only five sheets of test sample fulfill the requirements above, re-test must be performed to the eight new sheets of test sample and all must fulfill the requirements on Table 7.

7.7 Penetrate Resistance

When six sheets out of eight sheets of layered safety glass in size of 300 mm x 300 mm made in accordance with original glassmaking method, when tested according to test point 6.7 then glasses are declared have passed the test.

If only four sheets of test sample fulfill the requirements above, all glass samples is declared have failed the test.

If only five sheets of test sample fulfill the requirements above, re-test must be performed to the eight new sheets of test sample and all must fulfill the requirements on Table 8.

7.8 Collision Resistance on Mannequin Head

7.8.1 Using original glass size

When four out of five sheets of laminated glass for motorized vehicle have passed the test at point 6.8, glasses are declared have passed the test.

If only two sheets or less of test sample that fulfill the requirements above, all glasses are declared have failed the test.

If only three sheets that fulfill the requirements above, test must be re-performed against five new sheets of test sample and all samples must fulfill the requirements.

7.8.2 Using glass sample

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Glass sample with size of $1100 \text{ mm}^{+5 \text{ mm}}_{-2 \text{ mm}}$ x $500 \text{ mm}^{+5 \text{ mm}}_{-2 \text{ mm}}$

If only four sheets out of five sheets of laminated glass with size of:

+ 5 mm + 5 mm

1100 mm x 500 mm

- 2 mm - 2 mm

which made in accordance with original glassmaking method have passed the test as provided at point 6.8 all glasses are declared have passed the test. If only two sheets or less of test sample that fulfill the requirements above, all glasses are declared have failed the test.

If only three sheets that fulfill the requirements above, test must be re-performed against five new sheets of test sample and all samples must fulfill the requirements.

7.9 Abrasion Resistance

When three sheets of layered safety sample glass for motorized vehicle with size of 100 mm x 100 mm which made in accordance with original glassmaking method and in center there is a hole with diameter of 10 mm have passed the test as provided at point 6.9 all glasses are declared have passed the test.

If only two sheets of test sample that fulfill the requirements above, test must be re-performed against three new sheets of test sample and if all samples fulfill the requirements all glasses are declared have passed the test.

7.10 Moisture Resistance

When three sample sheets of laminated sample glass with size of 300 mm x 300 mm cut from its original glass where one of its side constitute the upper part from its original glass or made in accordance with original glassmaking method when tested according to point 6.10 if all glasses fulfill the requirements glasses are declared have passed the test, if only two sheets that fulfill the requirements test must be re-performed against three new sheets of test sample and if all samples fulfill the requirements all glasses are declared have passed the test.

Pass requirements are as provided at Table 10.

Table 10 Amount of sample and pass requirements

No	Quality Requirements	Types and amount of test sample	Pass Requirements
1.	Visibility character	Original glass size n = 3	Acc = 0, Re = 1 n = 3, Acc = 0
2.	Dimension and tolerance	Original glass size n = 3	Acc = 0, Re = 1 n = 3, Acc = 0
3.	Optic quality:		
	1. Light transmission	Test sample with size of 100 mm x 50 mm cut from original glass size or made according to original glass size n = 3	Acc = 0, Re = 1 n = 3, Acc = 0
	2. Optical deviation and distortion	Original glass size n = 3	Acc = 0, Re = 1 n = 3, Acc = 0
	3. Color identification	Original glass size n = 3	Acc = 0, Re = 1 n = 3, Acc = 0
4.	Radiation Resistance	Test sample with size of 300 mm x 300 mm or 300 mm x 76 mm cut from flattest part of original glass size or made in accordance to original glass size n = 3	Acc = 0, Re = 1 n = 3, Acc = 0
5.	High Temperature Resistance	Test sample with size of 300 mm x 300 mm cut from original glass size where one of its side	Acc = 0, Re = 1

		constitute the actual side of original glass size $n = 3$	$n = 3, \text{Acc} = 0$
6.	Collision Resistance	Test sample with size of 300 mm x 300 mm made in accordance to original glass size $n = 8$	$\text{Acc} = 2, \text{Re} = 3$ $n = 8, \text{Acc} = 0$ $\text{Re} \geq 4$, failed
7.	Penetrate Resistance	Test sample with size of 300 mm x 300 mm made in accordance to original glass size $n = 8$	$\text{Acc} = 2, \text{Re} = 3$ $n = 8, \text{Acc} = 0$ $\text{Re} \geq 4$, failed
8.	Mannequin Head Collision Resistance	<p>1. Original glass size $n = 5$</p> <p>2. Test sample with size of 110 mm^{+ 5 mm} x 500 mm^{+ 5 mm} - 2 mm - 2 mm</p> <p>made in accordance with original glass size $n = 5$</p> <p>Test sample size 100 mm x 100 mm made in accordance to original glass size and in the center there is a hole with diameter of 10 mm.</p> <p>$n = 3$</p> <p>Test sample with size of 300 mm x 300 mm cut from original glass size where one of its side constitutes the original glass</p>	<p>$\text{Acc} = 1, \text{Re} = 2$ $n = 5, \text{Acc} = 0$ $\text{Re} \geq 3$, failed $\text{Acc} = 1, \text{Re} = 2$ $n = 5, \text{Acc} = 0$ $\text{Re} \geq 3$, failed</p> <p>$\text{Acc} = 0, \text{Re} = 1$ $n = 3, \text{Acc} = 0$</p>
9.	Abrasion Resistance		

10.	Moisture Resistance	size. n = 3	Acc = 0, Re = 1 n = 3, Acc = 0
NOTES n = amount of sample Acc = <i>Acceptance</i> Re = <i>Reject</i>			

8 Marking Requirements

Product and product package must be at least affixed: permanently layered glass product mark, name and symbol/company's logo.

9 Packaging

Product packaged in box or strong pallet, using noise or collision damping material and orderly stacked to prevent friction from the sheets.

Appendix A (informative)

Optical Testing Zone of Safety Glass for Road Vehicles

A.1 Windscreen

A.1.1 Procedure I (Testing Zone A, B and I based on V and O points)

A.1.1.1 Scope

This procedure explains how to determine Testing Zone for windscreen based on focus V and O and determination of Testing Zone for right hand drive vehicle, and can be used for left hand drive vehicle by changing the positive and negative signs on "Y" coordinate. "In case of absence of R point, Testing Zone will be determined by procedure II".

A.1.1.2 Definition

A.1.1.2.1 Seat standard point (R point) is H point position (body point or dummy's feet circle). If dummy placed on adjustable seat or standard position in the design. Seat is positioned at the most rear position (backward or forward, if applicable), at the lowest position (up and down, if applicable) and oblique angle is adjusted according to the design (if the incline of seat cushion is adjustable).

A.1.1.2.2 Vehicle's center meridian is a straight line as mentioned below, if vehicle is positioned on a flat surface:

- (1) Straight line which through the centerline connecting left wheel and right wheel centerlines of front and rear wheels of four or more wheels vehicles.
- (2) Straight line which through the centerline connecting left wheel and right wheel centerlines of front and rear wheels of three wheels vehicles.
- (3) Straight line equally divides the distance between centerline of tractor's right and left drive wheel

A.1.1.2.3 Vehicle's center meridian plane (S_1). Vertical plane including vehicle's center meridian plane.

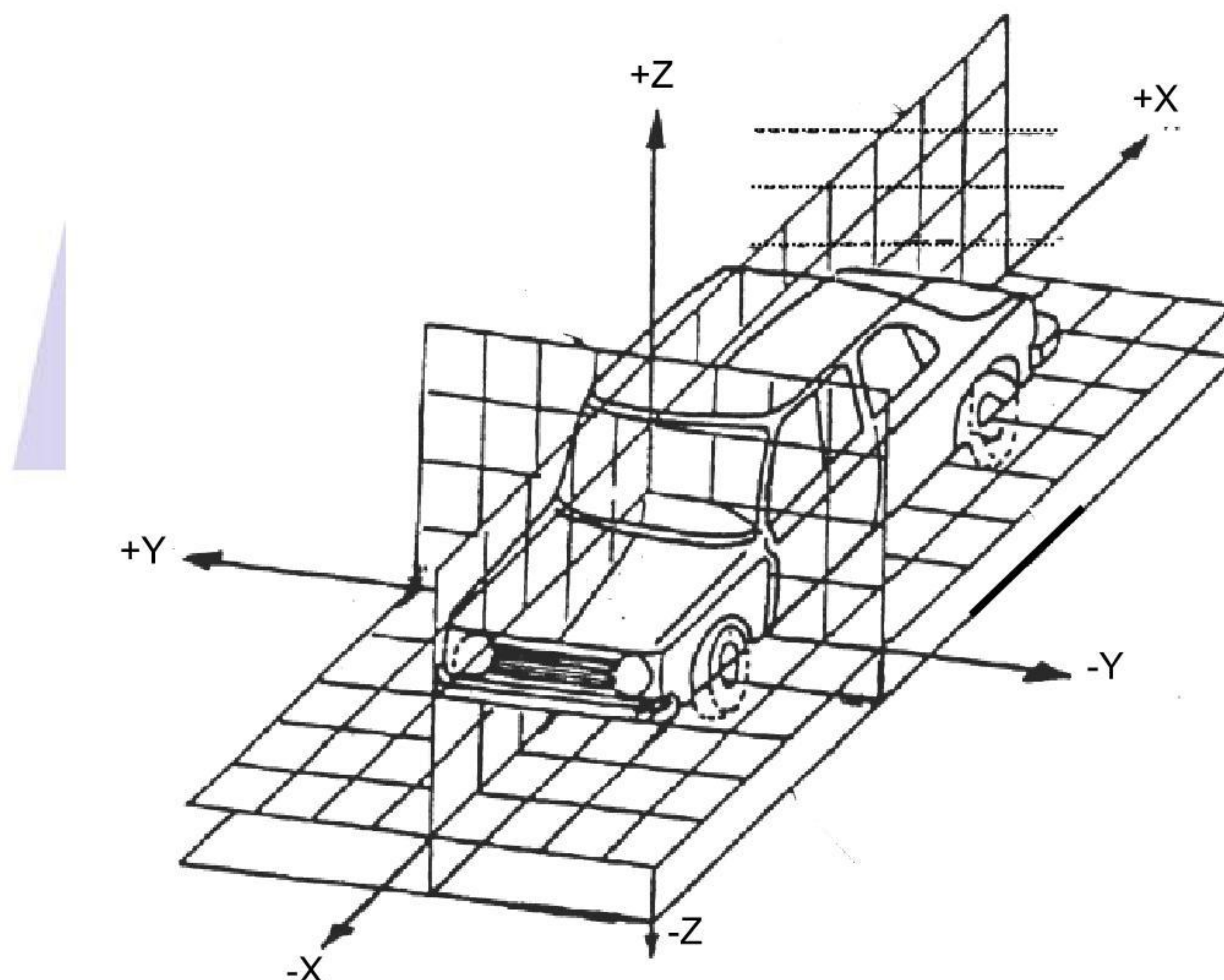
A.1.1.2.4 X-axis, axis line at horizontal plane which through the R point and parallel with center meridian.

X+: towards vehicle's rear

X-: towards vehicle's front

A.1.1.2.5 Y-axis, axis line at horizontal plane which through the R point and cuts across linearly with X-axis.

A.1.1.2.6 Z-axis, axis line at vertical plane yang which through the titik R and cuts across linearly with X- axis and Y- axis.



Gambar A.1a Vehicle Testing Zone

A.1.1.3 A and B Testing Zone Based on V1 Point

(1) V Point Position

(1.1) V point position obtained by using R point and shifted as illustrated at Table A.1 and Table A.2, three dimensions orthogonal ordinate system.

(1.2) Table A.1 shows basic coordinate for 25° seat cushion incline. Said coordinate direction is as illustrated at figure A.3.

Tabel A.1 Basic Coordinate

V Point	X (mm)	Y (mm)	Z (mm)
V ₁	68	5	665
V ₂	68	5	589

(1.3) Table 2 shows the correction for X coordinate and Z coordinate of Table 1 appendix, if seat cushion design is not 25°, said coordinate direction is as illustrated at figure A.3.

Tabel A.2 Correction of X and Z coordinates

Seat Incline (°)	Horizont al Coordina te X (mm)	Vertical Coordinat e Z (mm)	Seat Incline (°)	Horizonta l Coordinat e X (mm)	Vertical Coordina te Z (mm)
5	-186	28	23	- 17	5
6	-176	27	24	- 9	2
7	-167	27	25	0	0
8	-157	26	26	9	- 3
9	-147	26	27	17	- 5
10	-137	25	28	26	- 8
11	-128	24	29	34	- 11
12	-118	23	30	43	- 14
13	-109	22	31	51	- 17
14	- 99	21	32	59	- 21
15	- 90	20	33	67	- 24
16	- 81	18	34	76	- 28
17	- 71	17	35	84	- 31
18	- 62	15	36	92	- 35
19	- 53	13	37	100	- 39
20	- 44	11	38	107	- 43
21	- 35	9	39	115	- 47
22	- 26	7	40	123	- 52

(2) Testing zone

(2.1) Testing Zone is a windscreen surface bordered by four extension planes from V point towards X- point (see appendix at figure A.1b).

a. Parallel plane toward Y- axis which through the V1 and forming 3° angle toward

horizontal plane toward Z+.

- b. Parallel plane toward Y- axis which through the V2 and forming 1° angle toward horizontal plane toward Z-.
- c. Vertical plane which through the V1 and V2, and forming 13° angle toward vertical plane toward Y+.
- d. Vertical plane which through the V1 and V2, and forming 20° angle toward vertical plane toward Y-.

(2.2) Testing Zone B is a windscreen surface bordered by four extension planes from V point towards X- point (see appendix at figure A.2).

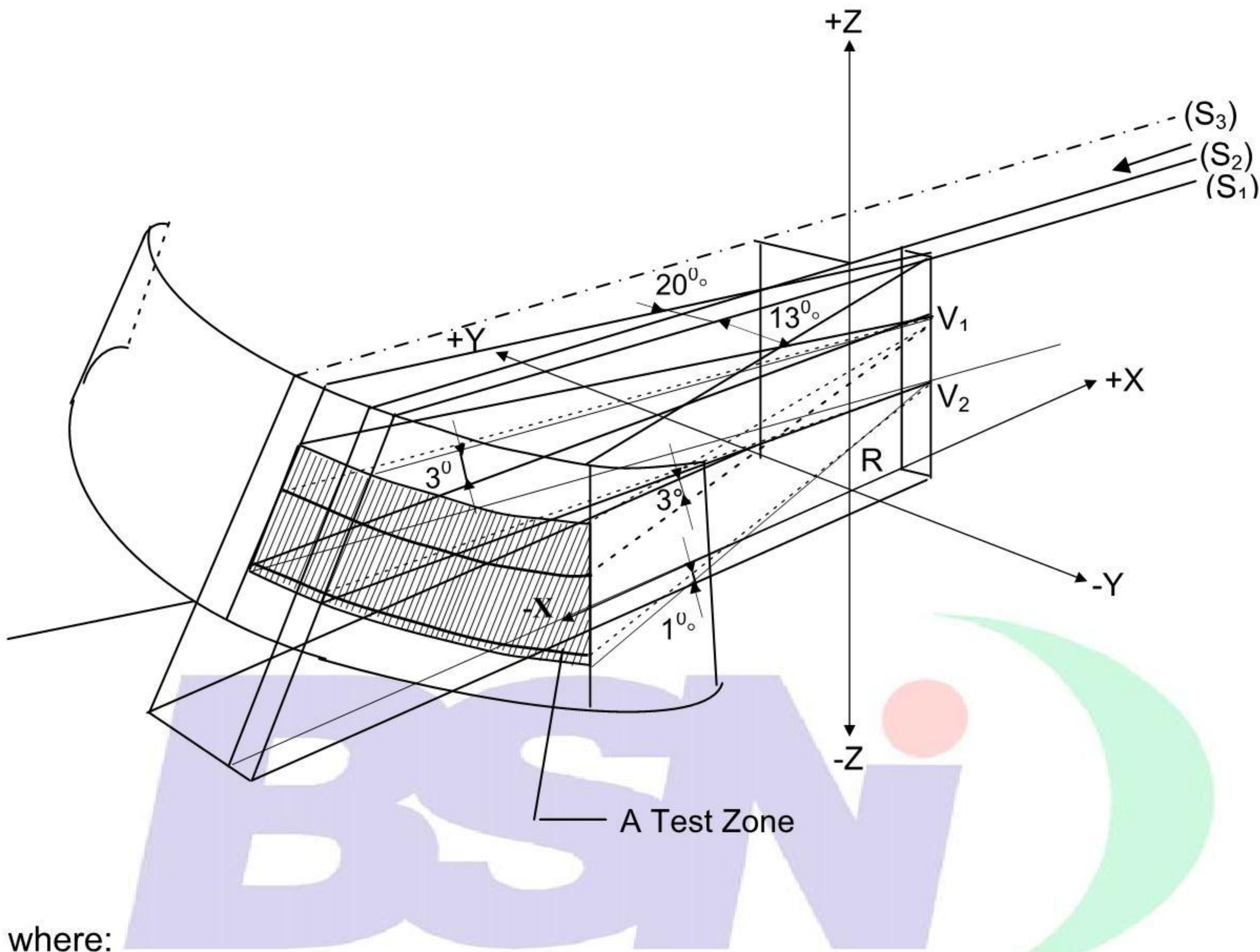
- a. Parallel plane toward Y- axis which through the V1 and forming 7° angle toward horizontal plane toward Z+.
- b. Parallel plane toward Y- axis which through the V2 and forming 5° angle toward horizontal plane toward Z-.
- c. Vertical plane which through the V1 and V2, and forming 17° angle toward vertical plane toward Y+.
- d. Vertical plane which through the V1 and V2, and forming 17° angle toward vertical plane toward Y-.

Area in 25 mm around peripheral zone or 25 mm from inside edge of ceramic is excluded from the above stipulation.

A.1.1.4 I Testing Zone Based on O

- (1) O point position. O point is a point on plane which through the drive wheel system center and parallel toward vehicle's center median plane at the distance of 625 mm from R point on driver's seat position toward Z-.
- (2) Testing Zone. I testing zone is windscreen surface bordered by four planes as follows:
 - a. A plane which through the OQ straight line and forming 10° angle toward horizontal plane toward Z+.
 - b. A plane yang which through the OQ straight line and forming 80° angle toward horizontal plane toward Z -.
 - c. A plane yang which through the O straight line and forming 15° angle toward vehicle's center meridian toward Y+.
 - d. A vertical plane symmetrically toward (c) plane and located at Y- direction.

CATATAN OQ straight line is horizontal straight line through the O point and perpendicular toward vehicle's center meridian plane.



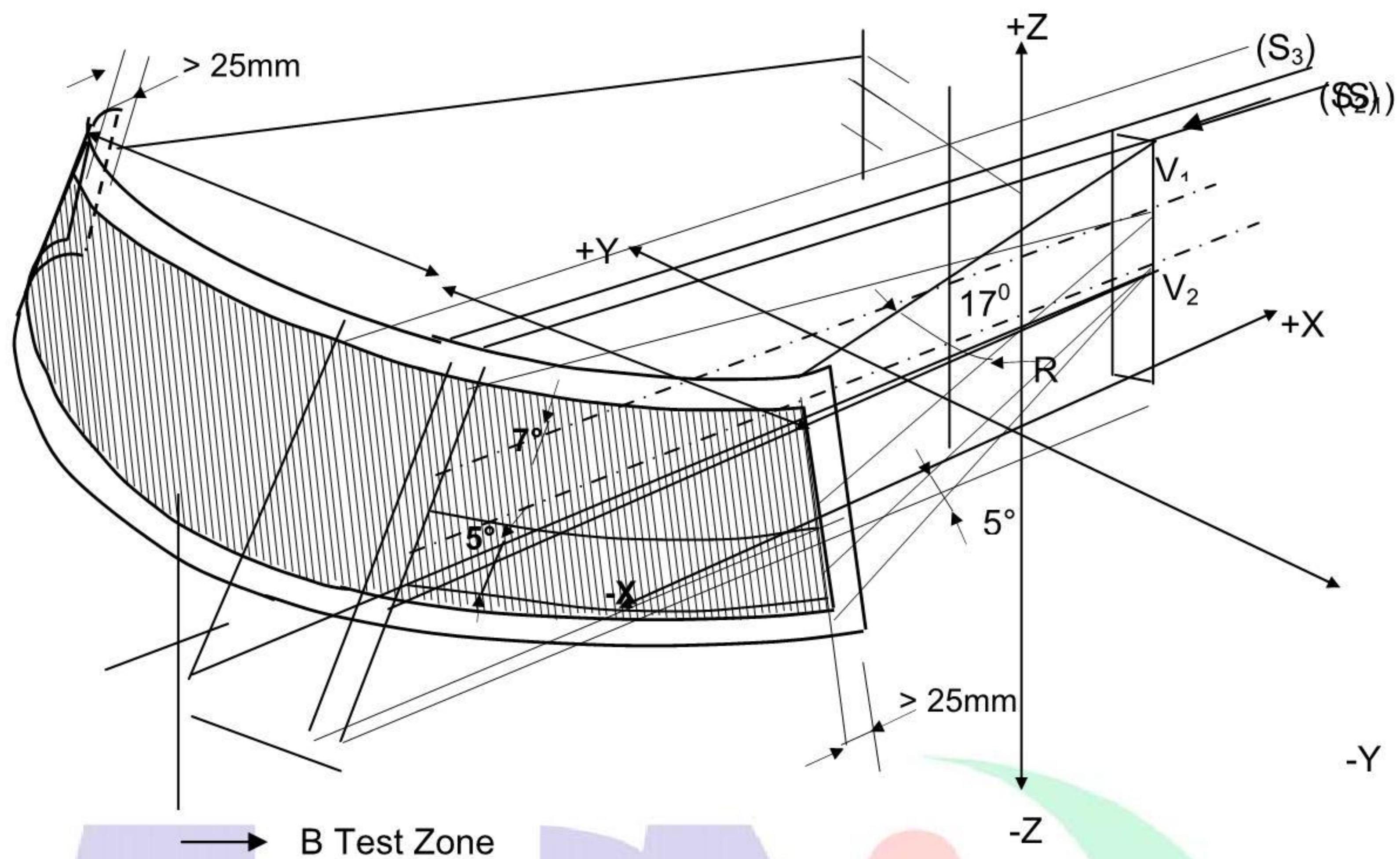
where:

(S₁) is vehicle's center meridian plane;

(S₂) is a plane which through the R point and parallel with (S₁);

(S₃) is a plane which through the V₁ and V₂ point and parallel with (S₁).

Gambar A.1b A Testing Zone



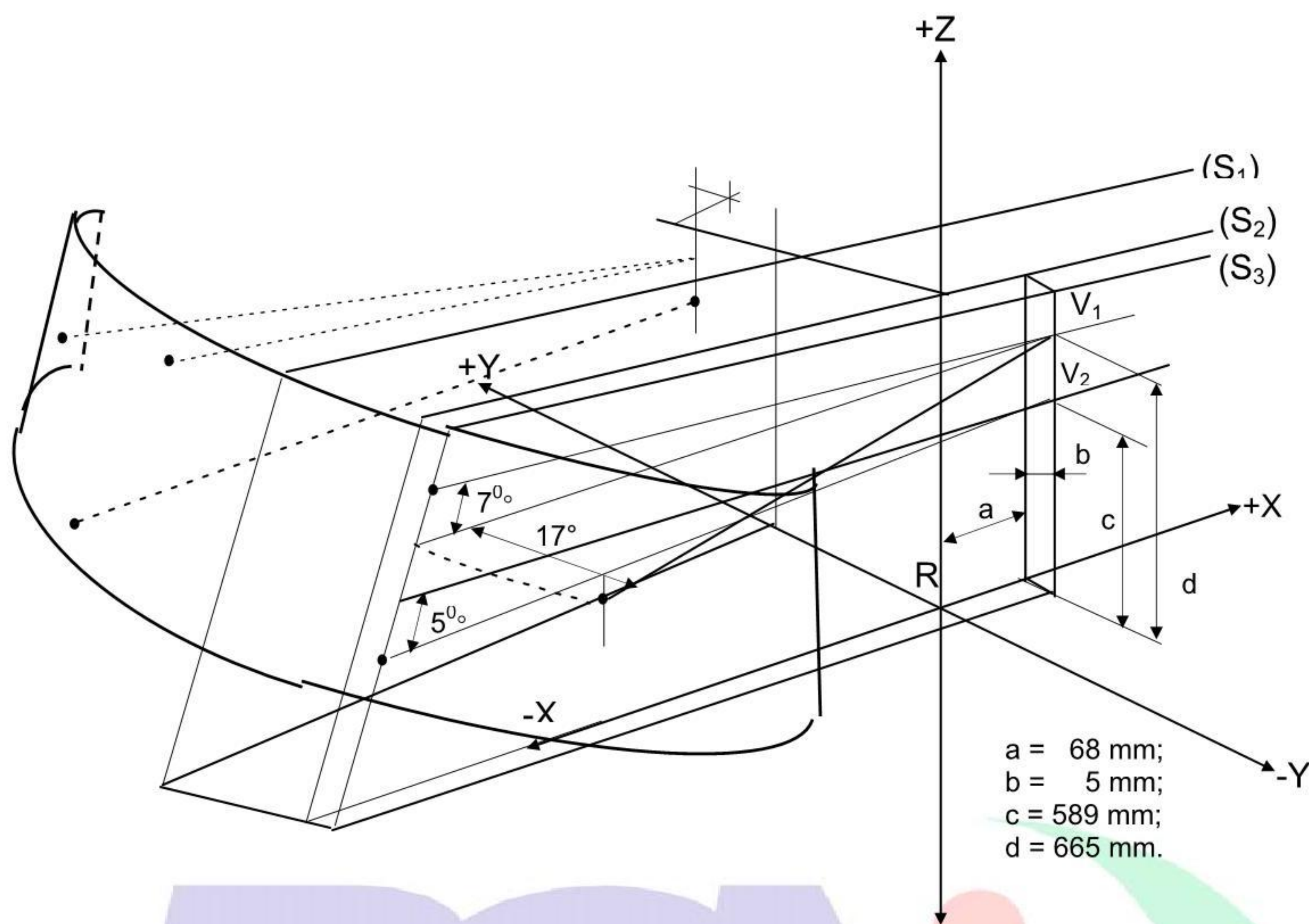
where:

(S₁) is vehicle's center meridian plane;

(S₂) is a plane which through the R point and parallel with (S₁);

(S₃) is a plane which through the V1 and V2 point and parallel with (S₁).

Gambar A.2 B Testing Zone



where:

(S₁) is vehicle's center meridian plane;

(S₂) is a plane which through the R point and parallel with (S₁);

(S₃) is a plane which through the V1 and V2 point and parallel with (S₁).

Gambar A.3 V point for design of 25° seat cushion incline

A. 1.2 Procedure II (Testing Zone a, b, c, if V and O points is unusable)

A.1.2.1 Ruang lingkup

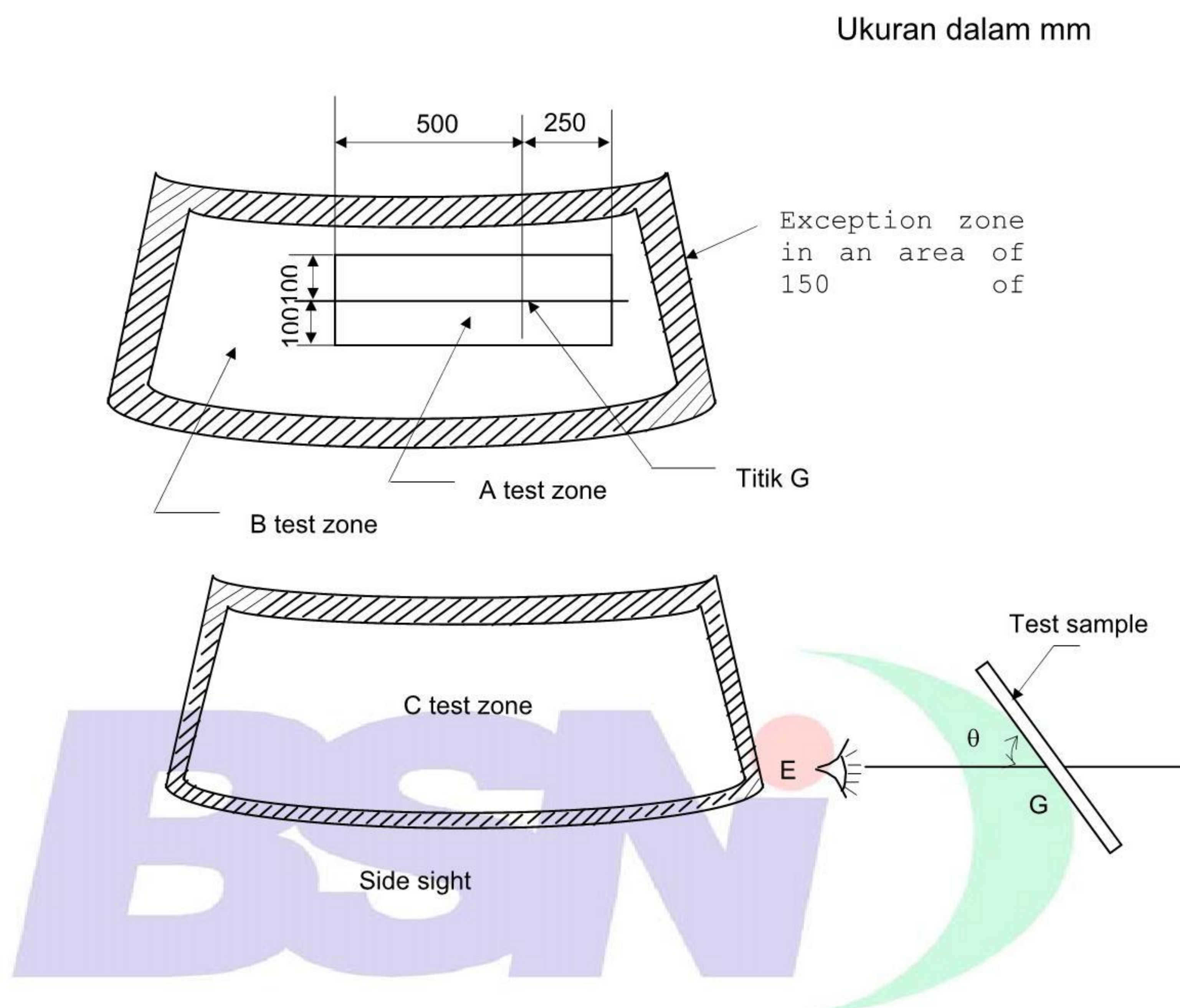
This is to explain the procedure to determine windscreen test zone if V and O points is unusable.

NOTE This testing zones is applied for vehicles where in its normal operation is not operated in public road, such as vehicles for construction project, plantation, forestry etc.

A.1.2.2 Daerah pengujian a, b dan c

Windscreen test sample intersecting line with straight line which through the driver's sight and parallel with vehicle's center meridian line when the glass mounted on the vehicle, called as G point. a, b, and c testing zones as mentioned on figure A.4 based

on said G point.



Note:

- a testing zone is 100 mm up and down, 250 mm toward the driver and 500 mm to opposite direction, refer to G point.
- c testing zone is inside zone with distance of 10 mm from mounting frame.
- θ is glass mounting incline angle in the vehicle.
- E is driver's sight.

Gambar A.4 a, b, and c testing zone

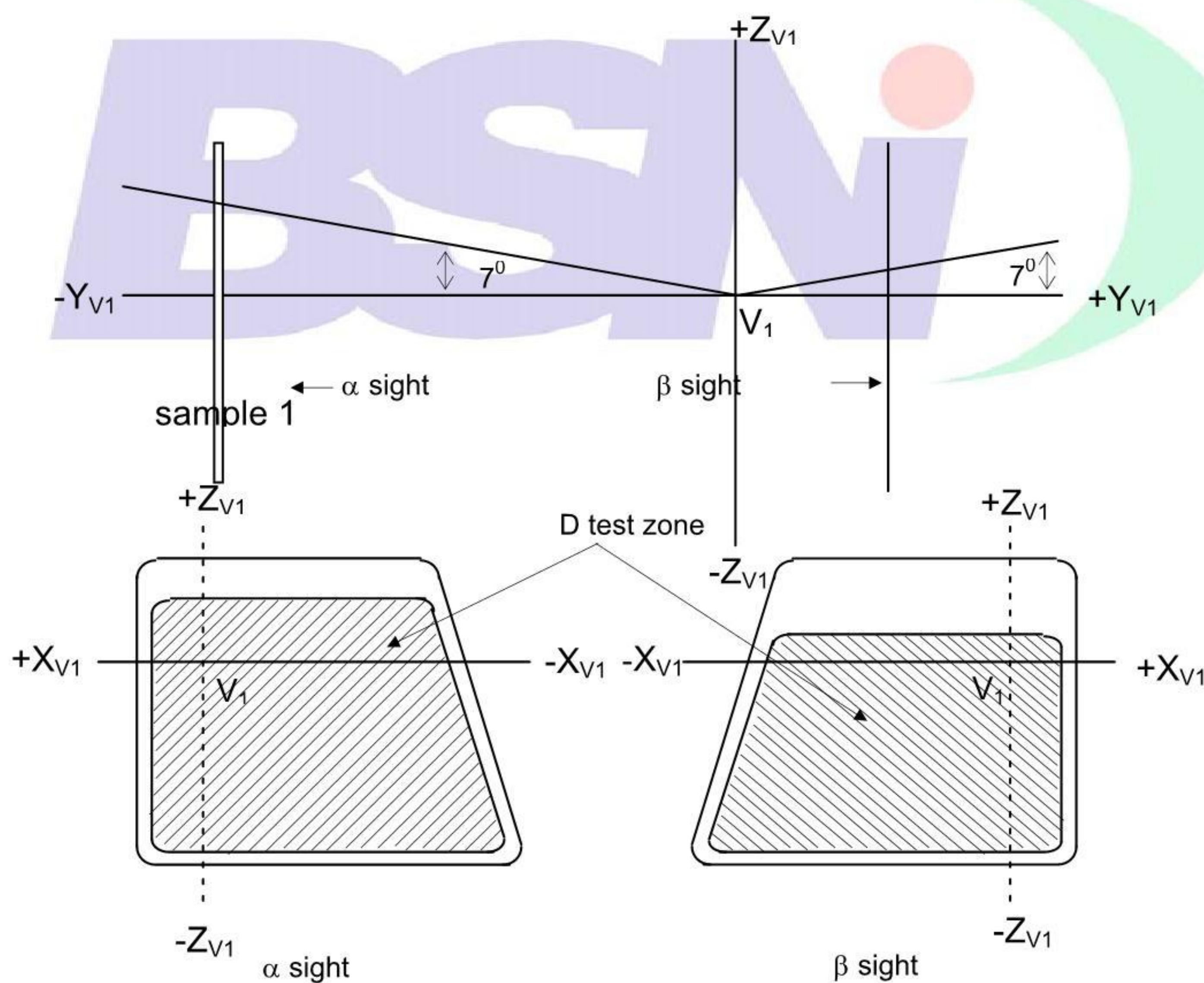
A.2 Testing zone for side window

A.2.1 D and E testing zones for side window (other than glass behind the driver)

(1) testing zone is remaining zone of side window, if zone stipulated below is expelled (see figure A.5).

a) Glass which touches lower part of the door.

- b) Upper part of the line where side window cross over with plane which through V_1 , X-axis tends to lean to 7° .
 - c) Zone inside the distance of jarak 10 mm from mounting frame or other parts of body which overlap, and glass zones which overlapped when glass is closed.
 - d) Marking on the glass.
- (2) E testing zone is remaining zone side window, if zone stipulated below is expelled (see figure A.6)
- a) Glass which touches lower part of the door.
 - b) Upper part of the line where side window cross over with plane which through O , X-axis tends to lean to 10° .
 - c) Zone inside the distance of jarak 10 mm from mounting frame or other parts of body which overlap, and glass zones which overlapped when glass is closed.
 - d) Marking on the glass.



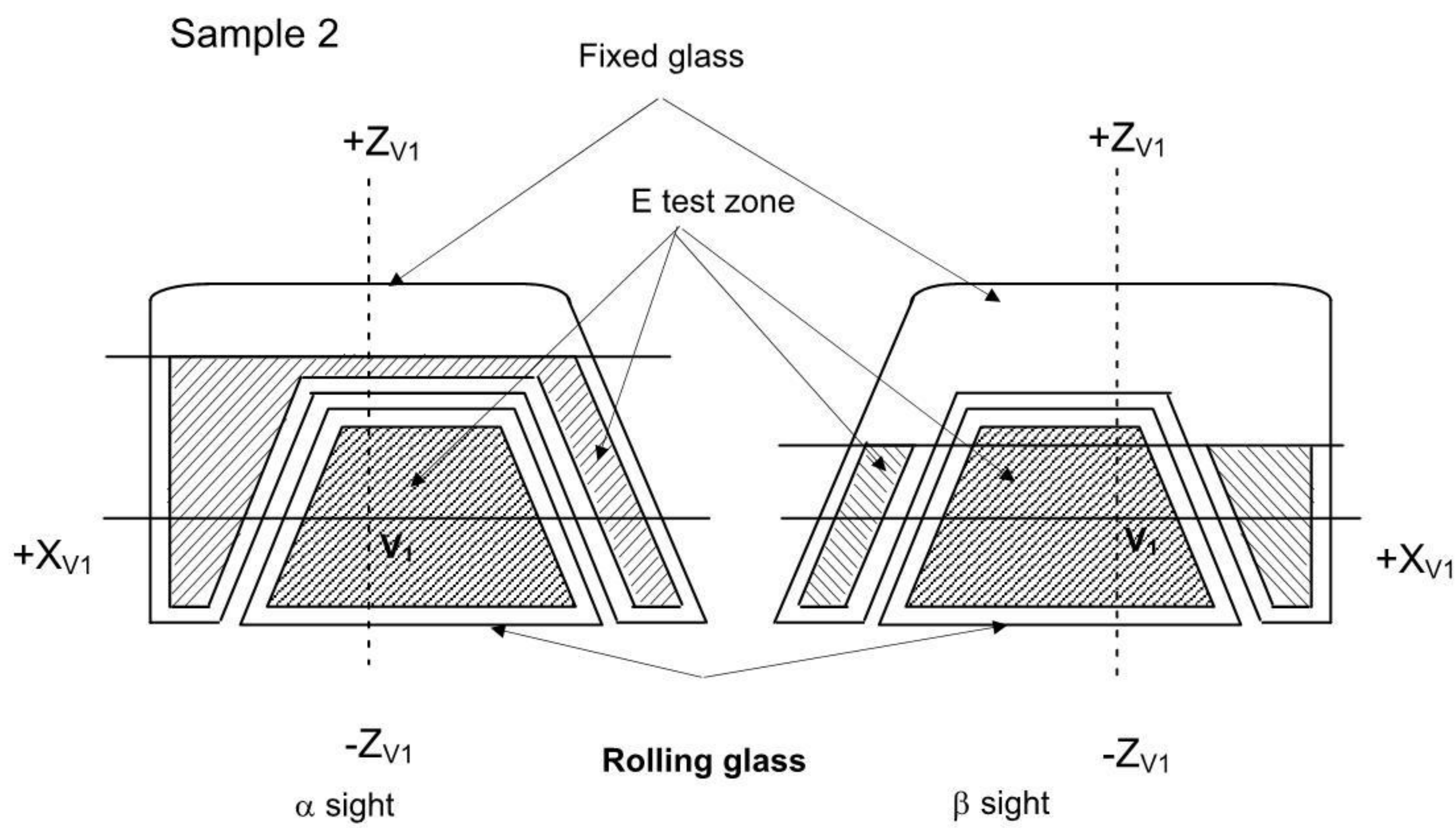
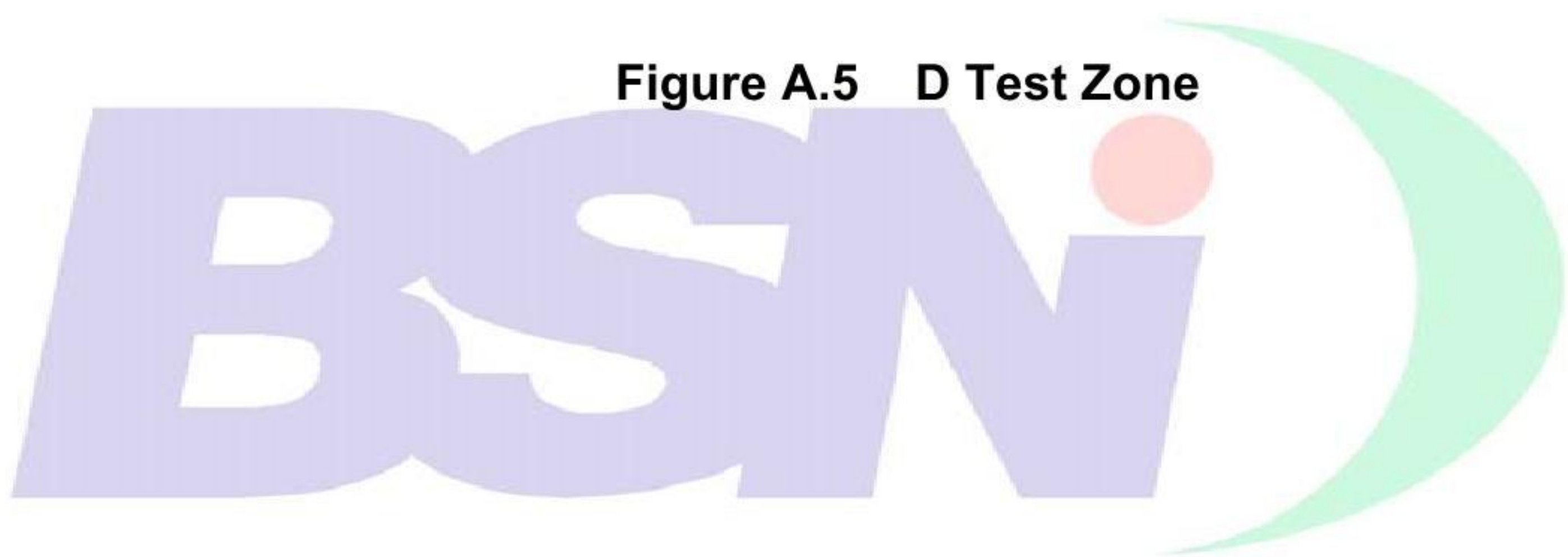


Figure A.5 D Test Zone



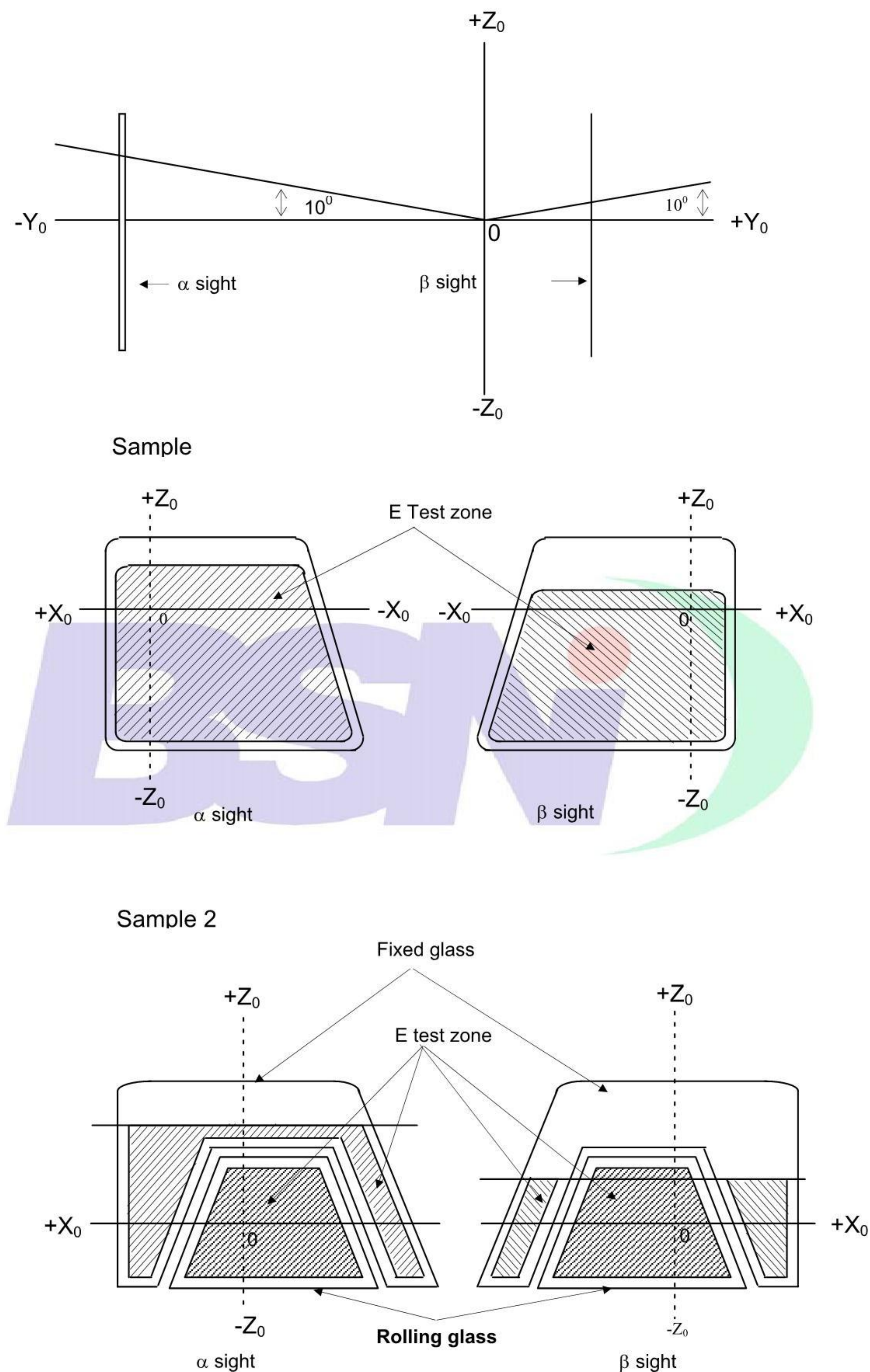





Figure A.6 E Test Zone

Appendix B (normative)

Double Sampling

Tabel B.1 Double Sampling

Total in group which valued	Sample taken	Total cumulative sample	Acceptance standard and limits of accepted/rejected								Note
			0,065		1		4		6,5		
			Pass	Failed	Pass	Failed	Pass	Failed	Pass	Failed	
2 s/d 8	I 2 II 2	2 4					+	+		↑	 use the first pass/fail values below the arrow  use the first accepted/rejected values above the arrow
9 s/d 15	I 3 II 3	3 6						↑		↓	
16 s/d 25	I 5 II 5	5 10						↓	0 1	2 2	
26 s/d 50	I 8 II 8	8 16			+	↓	0 1	2 2	2 3	3 4	
51 s/d 90	I 13 II 13	13 26				↑	0 3	3 4	3 4	4 5	
91 s/d 150	I 20 II 20	20 40					1 4	4 5	4 6	5 7	
151 s/d 280	I 32 II 32	32 64			0 1	2 2	2 6	5 7	5 8	7 9	
281 s/d 500	I 50 II 50	50 100		0 3	3 4	3 8	7 9	5 12	9 13	I. First sample II. Second sample Pass = accepted Failed = rejected + Use single sampling	
501 s/d 1.200	I 80 II 80	80 160	↑ ↓	1 4	4 5	5 12	9 13	7 11	18 19		
1.201 s/d 3.200	I 125 II 125	125 250	+	2 6 7	5	6 18	11 19	11 16 26 27			
3.201 s/d 10.000	I 200 II 200	200 400		3 8 9	7 ↑	11 16 26 27					
10.001 s/d 35.000	I 315 II 315	315 630		5 9 12 13							
35.001 s/d 150.000	I 500 II 500	500 1000	0 1	2 2	7 11 18 19						
150.001 s/d 500.000	I 800 II 800	800 1600	0 3 4	3	11 16 26 27						
500.001 s/d keatas	I 1250 II 1250	1250 2500	1 4 5	4							

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